ENGINEERING NEWS

Mr. JOHN F. WARD, Civil Engineer and Contractor of Jersey City, N. J., is now executing an interesting piece of submarine pipe-laying at Governor's Island in this city, under contract with the U. S. Quarter-Master's Department. The pipe-line is 6 in. diameter, with the WARD flexible joint, is 2,300 ft. long, and is laid in water about 50 ft. in maximum depth. The line runs from the foot of King street, in Brooklyn, to Governor's Island. The pipe is in ordinary 12-ft. lengths as laid. After each joint is made, the pipe is enclosed between the bells in two timbers 7×14 in., hollowed out and connected for the 11 ft. length of the timbers by four ¾-in. lag-screws, each 11 ins. long. As each joint is made that length is hauled into the stream by an 1¼ in. wire cable worked from the steam-hoist of a wrecking-scow stationed at one end of the line. The cable attachment to the pipe is made as follows: At the forward end is a 4 ft. length of pipe with an ordinary bell-end; back of this bell is a cast ring with lugs, and on the front end of the pipe is a cap with guide lugs; between the cap lugs and through the lugs in the ring, passes a U-shaped iron secured by nuts, and to this loop the hauling wire is attached As the enclosing timbers make a box 14 ins. square between the bells, the hauling across the channel is comparatively easy. With everything in good working order, the lead-joint is poured and caulked, the timbers bolted on and the pipe-line hauled forward one length, or 12 ft, in 6 minutes. As it takes one minute to do the hauling, this shows rapid joint-making. In this case it was found that the pipe was being hauled through a scow-load of mud, etc., "accidentally" dumped in this channel. As noted in our issue of Oct. 1, a late test of a 6 in. pipe with the WARD flexible joint showed on a tensile test an ability to stand a pull of of 145,600 lbs., or nearly 73 tons, before the lead stripped out.

G. W. PEARSONS, Chief Engineer of the National Water Works of Kansas City, tells us that the late failure in the Quindaro reservoir in that city was from the sinking of one of the division walls in the basin, and was probably due to a soft spot in the foundation. Though, as the reservoir is still full of water and will remain so until next Spring, the exact cause will only then be discovered when repaired. The wall had a base of 12 ft.; top width of 7 ft., and height of 21 ft.; it was founded on a grillage, 14 ft. wide, bedded in concrete, as shown on page 401 of ENGINEERING NEWS of this month. The wreck as seen through the water shows the wall in large masses, proving that the masonry was good. As the weight of the wall was 11 tons per lin. ft., and the water pressure upon it at the time of the accident only 1,800 lbs. per. lin. ft., the wall did not fail from lack of section, The rumor that the stack and other parts of the structure are failing is denied positively. There has been, however, some slipping in the bank of the reservoir where it abuts on a ravine, but there is no leaking.

IT is reported on the authority of E. W. SERRELL, the Chief Engineer, that work has been commenced upon the bridge which is to span the Hudson just above Peekskill. N. S. HAIGHT, the Engineer-in-Charge, is said to be staking out work for the contractor at Fort Clinton. This structure is intended to cross the river in one span from Anthony's Nose to Fort Clinton by a suspension bridge, with a total length of 3,000 ft., height to rail of 195 ft. and to top of towers, 330 ft. This so-called Highland bridge is designed to form a direct connection between the Erie R. R., at Turner's station, and the New York City & Northern R. R., and further afford communication between all New England and the railway systems west of the Hudson at this point.

ON Dec. 13, the Secretary of War awarded the contract of excavating the portion of the Harlem River Ship Canal, lately let, to JOHN SATTERLEE & Co., of Englewood, N. J. Their bid was 93 cts. per cu. yd. for material above water and $1.13 per cu. yd. for all below water-line. The total of the appropriation for this work is $400,000.

Gen. NEWTON, Commissioner of Public Works of New York City, replies to a committee of the Chamber of Commerce that $2,000,000 will be required to put the down-town streets of this city into prime order.

WORK has been commenced on the new Lake tunnel at Chicago at the shore shaft.

PLANS and specifications have been ordered by the authorities of Cleveland, O., for a new lake tunnel at that city. This new tunnel is to be 7 ft. in diameter. and about 1¼ miles long, lying at an average depth of 70 ft. below the lake surface, or 30 ft. below the bottom. It is to cost $300,000 and to be finished in two years.

THE Mayor of Newark, N. J., recommends the immediate building of works to bring water to that city from the Pequonnock river at an estimated cost of $3,000,000.

THE elevation of the tracks of the Philadelphia & Reading R. R., in Philadelphia, is again being agitated. The bone of contention is the abandonment of the Pennsylvania Avenue line from Broad and Callowhill through Fairmount Park to the Columbia Bridge. The company is unwilling to give up this line—with its valuable freight traffic—and the large industrial works on the route, like the Baldwin Locomotive Works, are also dependent upon it solely for track accommodations. Though any attempt to elevate will be bitterly opposed by large property holders on Broad street, as near as can be now learned, the latest plans involve the elevation of the main line west of Broad street, with elevated tracks down Willow street to an intersection with another elevated road coming from Germantown and the Falls bridge down between 9th and 10th streets to Market street. The Willow street line would pass on to the Delaware river for freight purposes as now, but be an elevated instead of a surface line. Plans prepared by the Phœnix Bridge Co. are now on file, proposing to build an iron elevated structure, 60 ft. wide, for $490,000 per mile. But property on the proposed route to Market street has advanced since the project was first broached, some years ago, from $1,300 to $2,500 per ft. The estimated value of property on Market street is now $3,500 per ft. Nothing definite can, however, be stated of either the plans of the railroad company or the constructive detail of the proposed improvement. All that is certain is that the abolition of all grade-crossings is imperatively demanded.

THE stockholders of the Keely Motor Co. held a meeting in Philadelphia this week, the first meeting since 1883. About 150 holders representing 72,000 shares of stock were present. The Treasurers' report showed a balance of $58.44 on Dec. 14, 1882; since then $39,765.75 had been received. and $39,799.78 expended. The unfortunate Secretary complained that he was out of pocket for postage, and at times had to wear his ulster in the office for lack of money to buy fuel. Mr. KEELY was not present, but was represented by Mr. CHARLES B. COLLIER who read a voluminous report from Mr. KEELY. This report was mysterious and vague, but very hopeful. The inventor says he abandoned the "vaporic or etheric force" some time ago owing to the impossibility of securing graduation. But he had discovered a new force which he calls "vibratory sympathy" which "may be divided again into negative and sympathetic attraction." Mr. KEELY makes no promises, but thinks he can bridle this new force so as to run either a sewing machine or a steamship. The report was accepted, and new officers elected. It seems 62,000 shares of stock are held in New York, 20,000 shares in Philadelphia, and the remaining 18,000 in the West and South. Mr. KEELY is getting up a new company with $15,000,000 capital and had already disposed of 30,000 to 50,000 shares to raise money to prosecute his experiments. This portion of Mr. KEELY's report was suppressed, though it was understood that old stockholders were to receive share for share in the new company. Taking the report of the meeting as a whole, there seemed to be considerable lack of "vibratory sympathy" in the old organization.

THE following bridge accidents are reported: On Dec. 4, a coal train on the Jerome Park branch of the Colorado Midland Railroad was derailed on a trestle and went over, wrecking the structure. The accident occurred on a sharp curve. The track was being relaid, and the spikes had been drawn from the outer rail. A flagman failed to warn the engineer.——On Dec. 5 the small wooden bridge over Fire Prairie creek, near Buckner, Kan., on the Lexington branch of the Missouri Pacific Railroad, gave way under a freight train. Two cars were wrecked. —— On Dec. 12 a recently constructed trestle at Gowanus bay, between 35th and 36th streets, Brooklyn, N. Y., gave way under a construction train, throwing 5 cars into the water 15 ft. below. Four men were injured.

The most serious railroad accident of the week was a rear collision, Dec. 10, on the New York, Pennsylvania & Ohio Railroad at Akron, O. A through freight train ran into an extra freight which was running slow on account of the regular freight ahead. The engine and several cars were wrecked; the wreck took fire but the flames were extinguished by the fire department. Two men were fatally injured. The loss is estimated at $25,000.—— A collision between two freight trains occurred Dec. 11 on the Chesapeake & Ohio Railroad, near Clifton Forge, Va. Three men were killed.——A freight train from Glenwood Springs to Aspen, Col., on the Colorado Midland Railroad, ran into a landslide near Aspen on Dec. 8. The engine and 15 cars were wrecked. Two men were injured.

HEAVY rains have caused a rapid rise in the Alabama river. The draw span of the Louisville & Nashville Railroad bridge, 4 miles north of Montgomery, Ala., which was being rebuilt, was destroyed Dec. 11, the false works being swept away by the drift wood. One man was killed.

A STILL further reduction in the time of the transcontinental journey goes into effect Dec. 21. Trains will leave Chicago 7:30 P. M., arrive at Omaha the next morning, and at San Francisco at 10:40 A. M., on the fourth day, making the time from Chicago to San Francisco 3 days and 15 hours, and the time from New York to San Francisco 4 days and 16 hours.

THE Jersey City people are continuing to make asses of themselves in fighting the proposed Pennsylvania elevated tracks, which cost them nothing, and will probably be a great public safeguard, and advantage. Perhaps it would be more just to say that a little knot of them only are fighting, but it is discreditable that there should be any number. We trust there is no chance that this litigation will cause the company to throw up the whole improvement in disgust. And we infer there is not.

Mr. H. J. PEDDIE, of Edinburgh, boldly proposes to put a submarine tunnel across the Clyde by preparing a level bottom covered with clay in bags and then sinking on this a continuous tube of iron, and finally covering this tube with clay in bags, then opening the tube at the ends and lining it with brickwork. He claims great safety, facility of construction and moderate cost. He might first find trouble in handling his long tube in a tideway, and more trouble in keeping it on the bottom when he came to the pumping out and lining stage. It would probably prove less facile and cheap than the proposer seems to expect.

THE Manchester Ship Canal has encouraged other waterway schemes and the project to unite Birmingham with the river Trent by a short canal is again being agitated. The canal would only be 80 ft. wide but if the scheme succeeds Birmingham will have a waterway 7 to 9 ft. deep and 80 ft. wide to the North Sea, to be utilized by trains of barges towed by tugs. A saving of $1,500,000 per year in freight is estimated.

PITTSBURG reports speak well for bridge builders there. The Keystone works are said to be building a mile of elevated railroad for this city and a bridge 1,550 ft. long over the Missouri river at Kansas City, and also five other bridges for the Kansas & Oregon R. R. The Pittsburg Bridge works are also credited with over $200,000 of work for western railroads.

A New Bridge Truss.

BY GEORGE H. PEGRAM, M. AM. SOC. C. E.

(WITH INSET.)

Continued from page 416.

METHODS OF CALCULATIONS.—In curved chord trusses, or those of any irregular form, the stresses are best determined by means of graphical statics.

The results are practically exact and are obtained in about the same time as with the analytical methods, and the diagrams contain checks within themselves on false assumptions and inaccuracy of work.

The subject is so thoroughly treated in GREEN'S *Graphical Analysis of Roof Trusses* and kindred works, that it will not be necessary to explain its principles here. The work is often abridged by supplementing it with numerical computations.

The methods, which are the result of the author's experience in the determination of strains in irregular structures, will be illustrated by the practical case of a 255 ft. through span with double system of web bracing shown in Plate IV. All of the data are given in the plate. It will be observed that the systems are divided and the curved chord assumed to be straight between the panel points of *each system*. The stresses are determined for the separate systems as if they were separate trusses and afterwards combined similar to the present custom of treating parallel chord bridges with double web bracing. This is, of course, not the condition of things that really exists, and apparently fails to take into account the effect which one system of bracing has on the other through the curvature of the chord between the panel points of each system. In a large measure it does take this effect into account, or rather provides for it in a way that gives results in which the error is so small, with the slight curvature in the trusses formed on the principles herein set forth, that it may be disregarded.

The compression in the chord from one system tends to raise (in a through bridge, for example) the intermediate panel points of the other systems; but this is reactionary between the systems, *i. e.* each tends to relieve the other, and where, as in practical cases, the loads on the two systems are approximately equal, the result is a relief to *both* systems by the *chord*. Now, where the systems are divided and the broken chord lines between the panel points of one system replaced by straight lines, the angles between the chord lines at the panel points are doubled; but the chord strains are only half of the total strains, being due to the loads on one system, and the relief to the web nearly the same as if the actual chord line were used with both systems acting at the same time.

The *exact* calculation, however, involves no trouble but is simply a question of labor, and it may be more satisfactory to the reader to show just what the difference is. For this purpose the stresses are determined for the actual curved chord in Plate V, which will be explained later on. Plate IV requires very little explanation.

The reactions are computed numerically, and but half of each diagram is drawn, the check being had by calculating the middle chord stress independently. The tension in the part at the point where the ties change, *i. e.* slope downward from the right instead of from the left, will obviously be equal to the rising tendency of the chord joint. A regard to this will obviate any confusion in drawing complete diagrams.

In determining the live load web stresses the end reactions for the successive positions of the train are first computed, and the diagrams drawn from the end of the truss to the respective members whose stresses are to be determined. This is quickly done as there are no intermediate loads to deal with, and most of the lines of one diagram may be taken from the preceding one. It will be observed that the diagrams are not lettered. The members of the truss have an individuality of inclination which renders this unnecessary and considerable time can be saved by avoiding lettering, with no inconvenience after one has become practiced.

Plate V gives the determination of stresses, preserving the *actual* chord line, for comparison with Plate IV. The systems are divided as in Plate IV, but the chord is a broken line between the panel points of each system. When under compression the chord would tend to rise between the panel points. To be in equilibrium, and therefore statically determined, it requires the assumption of a *downward* force at each of these intermediate panel points equal to the rising tendency of the chords. This force exists in fact, in the relief which the chord furnishes the web of the other system, and should therefore, be represented by an equal *upward* force in determining the stresses in that other system.

These joint forces are so small compared with the stresses in the chords that considerable difference in the chord stresses, will make no appreciable difference in these forces. Therefore, if we get the chord stresses, as in Plate IV, *i. e.* with chord straight between alternate panel points, we can assume these stresses in the actual chord lines, and determine the resultant joint forces, which may then be combined with the loads to make the load line of the stress diagram. As an example, let us find the stress in tie *D f* for live load only, with head of the train at *f*. The reactions for the panel loads are computed, and the complete stress diagrams drawn, for chords straight between alternate panel points, (which for distinction had better be called the straight chord method) as in Plate IV. Diagram *f*, Fig. 6, (Plate V.) gives the stresses in the full system, and *f*, Fig. 7, the stresses in the dotted system. The dotted lines in the diagrams are parallel to the actual chord, and the vertical distance between them at the end of each chord stress is evidently the vertical resultant of the chord stresses at that joint, and the magnitude of the joint force required. The joint forces at *B*, *D*, *F*, *H*, *K* and *M* are upward forces because they represent the relief which the dotted system gives the full system. The forces at the other joints are downward, as they are the forces supplied by the web of the dotted system to hold the full system in equilibrium.

For the end reaction of these forces and the loads on the full system, we have (calling the span 14 top panels, to "round off"):

Upward reaction:

From loads: $[41.3 \times 7 + 32^4 \times 5 + 30.8 \times 3 + 31.9 \times 1] \div 12 =$	47,900
From forces: $[2.8 \times (3 + 5 + 7 + 9) + 2 \times 11] \div 14 =$	6,360
Total:	54,260

Downward reaction:

From forces: $4. \times 2 + 3.2 \times 4 + 2.8 \times 6 + 2.2 \times 10 + 2. \times 12] \div 14 =$	7,460
Resultant reaction	46,800

With this reaction, diagram *f* in Fig. 10 is drawn to get the stresses in *D f* and *D d* using, of course, the actual chord line.

For. Figs. 2, 3, 4 and 5, the joint forces are obtained by taking the chord stresses from Plate IV and laying them off on the dotted lines of Fig. 1, which are parallel to the straight chord panels, and scaling the resultant between the full lines, which are parallel to the actual or curved chord lines. The other figures are for the web members.

Stresses have thus been determined for all of the members of the truss, which are practically accurate. These stresses are marked *C* in the figure, and the stresses obtained by the straight chord method are marked *S*. The chord stresses by the two methods differ by about 1 per cent, the straight chord giving the highest results. The web stresses are nearly identical except in a few end members. these, in one system, are greater with the curved chord method, and in the other with the straight, but by amounts sufficiently small to be neglected especially as these members are so situated that they are not affected by impact and will not often receive the maximum stress. The difference would of course be greater with a sharper curvature, but probably in no case would exceed 3 per cent., and, therefore, where it is desired to be clearly in excess throughout, it might be advisable to add from 3 to 5 per cent. to the two end web members of the dotted system, rather than be troubled with the extra labor of calculation.

EXCELLENCE.—The first and most essential feature of a bridge is that it should be capable of exact analysis, or that the extremes of strain should be determinate; thus, it may be of little importance to know whether a bar is strained to 5,000 lbs. or to 10,000 lbs., provided we can be sure that it is not strained to more than 10,000 lbs. The next feature in importance, and the one most commonly violated, is that it should be as free as possible from secondary strains caused by non-coincidence of axes of stress with those of the members; eccentric attachments, flexure in columns produced by brackets, floorbeam and lateral rod attachments and connections with members which act independently, under the false assumption that the columns are stiffened thereby. Coming also under this head would be changes in fundamental conditions; such as the settlement of the intermediate supports of a continuous girder and the effects of temperature.

Next would come the wearing qualities or durability. This would, of course, include provision for possible accidents as well as the normal conditions of loading.

What is the best bridge to meet these requirements? Mr. T. C. CLARKE, M. Am. Soc. C. E., in his discussion of Mr. JOSEPH M. WILSON'S paper* "Specifications for Strength of Iron Bridges," gives an excellent epitome of "the principal improvements in bridges" in which he says:

"V. Improvements in design.

"1. Less depth of truss.

"2. The general use of long panels."

Mr. CHARLES B. BENDER, in his *Principles of Economy in the Design of Metallic Bridges*, says:

"It is evident that the idea of gaining stiffness by using shapes of considerable moments of inertia for the tensile as well as for the compression members, and of using only moderately long or short panels, and the mode of inter-riveting diagonals at the points where the diagonals and posts cross each other, is utterly erroneous. Such structures have only an apparent but wholly deceptive stiffness. They are not strong, for the members are more taxed by flexures than by their primary strains. The calculations of strains of such structures should invariably be extended to the secondary strains, for the primary strains, as resulting from the application of the common and elementary formulæ are untrustworthy. On the contrary, deep, long panel, pin-jointed structures, with eye-bars as tensional members, are almost entirely free from secondary strains. They are the best and most economical structures, provided that the principle of central intersection of gravity lines is not only applied to the main girders but also to the lateral and transverse bracing and to the attachments of the floor."

In another place regarding the depth Mr. BENDER says:

"Practice does not go so far but it is satisfied if the web-material equals the material of the chords; and even such depths as would be necessary to fulfill this condition are not reached in case of long spans, for the reason that the cost of manufacture and of handling heavy masses, the cost of transportation, the very important lateral and oblique stiffness to resist wind, the cost of scaffolding, of masonry and of erection, must be considered. The greater the span the more imperative becomes these considerations."

We see that these authorities favor the longest practicable panel and, indeed, it has become such a prominent feature of present good practice that no further argument should be necessary. It makes the best provision for the live load because it allows of the greatest train motion for any member to receive its maximum stress. It has been proven experimentally that the effect of impact decreases rapidly with the length of train motion, and this has been recognized in the substitution of plate girders for short panel trusses in small bridges, and in the sliding scale of percentages for impact commonly specified.

The new curved chord truss admits of the longest possible panels, considerably longer in through bridges than in the case of the Whipple, as will appear from the following considerations:

The top chords of the two trusses of a bridge are stiffened and made to act together as one long column by the top lateral bracing. Take a panel of the top lateral system (see figure) and let *P* be the length of a panel of chord; *L*, the length of the lateral rod, and *W*, the width between lateral connections. The shortening of the chord by a stress *S* will produce a compressive stress in the rod (assuming it to remain straight) of an amount $S^1 = S \times \frac{P^2}{L^2}$

In the case of the 255 ft. Whipple span (Plate II.) taking the width between lateral connections as 14 ft., or 2 ft. less than the distance between chord centers, $L = \sqrt{(21.25^2 + 14.^2)} = 25.45$; and *S*, for live load, = 6,000 lbs. per sq. in. Therefore, the lateral rod will be compressed by a stress $6{,}000 \times .7 = 4{,}200$ lbs. If an initial tensile stress of this amount should not

*Transactions of the American Society of Civil Engineers, June, 1886.

have been put in the rods, or if from wear or other causes it is lost, the rods will be slackened and the bridge rendered unsafe. Temperature, also affecting the rods more than the chords, parts of which are not exposed to the sun, would aggravate the trouble. A rod with flat inclination is also obviously less effective in holding the chord sections in line even if it is kept tight.

The flat inclination can be avoided by using two panels of bracing to one panel of top chord, but this is expensive and not ordinarily done.

With the bottom chord laterals the case is quite different. Here the rods are not needed to hold the chords in line and the only question is whether they may not be overstrained, when too flat, by the extension of the bottom chord. Take the case of a panel of the Whipple as above. The chord stress for live load is 7,500 lbs., and the stress in the lateral rods produced by the extension of the chords would be $7,500 \times .7 = 5,250$ lbs. This stress would of course be in both rods. The stress caused by the wind would be no greater than if the rods were not under stress upon the extension of the chords because one rod acts in compression up to the amount of its initial tension, thus reducing the ultimate stress in the other rod by this amount.

It is difficult to put an initial stress of any considerable amount in these bottom lateral rods, by adjustment, on account of their size, and it is unnecessary and unwise to do so, such a stress would, similarly to that induced by the chords, be in *both* rods, and thus only half as effective in increasing the total ultimate stress in the one rod affected by the wind and it could also be provided for by a slight increase in section if desired. In any case it could not reach an injurious amount, and wear would benefit matters rather than otherwise.

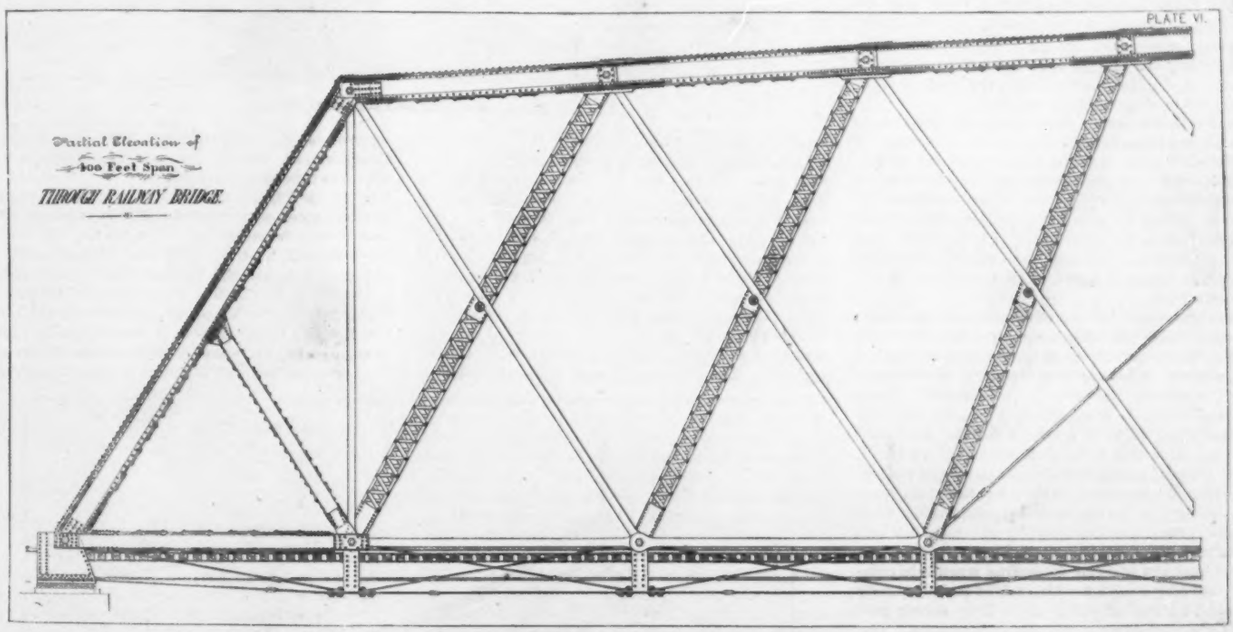
There is no limit to the length of bottom chord panels within the range which it is economical to make them, whereas we see that the top panels have limiting considerations, and, therefore, in the preceding pages it has been suggested to make the top panels of the curved chord truss the same as the Whipple as a proper basis of comparison. As in the Whipple the top and bottom panels must be of the same length, the curved chord truss has the advantage of a much longer bottom chord panel.

The through Whipple truss shown in Plate II, represents the best practice of the day. It is the type built by the late Col. C. SHALER SMITH, and has been extensively used, particularly on the Chicago, Milwaukee & St. Paul Ry., the Gulf Colorado & Santa Fé, the Canadian Pacific and the Atchison, Topeka & Santa Fé railways. The principal improvements, it will be observed, are in the end panel which is the Achilles heel of a Whipple truss. Let us consider this suspended panel. In the first place it is really not an integral part of the truss. It is a small bridge within a large one, subject to all of the objections to a small bridge, viz.: receiving its maximum stress suddenly with every passage of a locomotive, and having a small dead load in proportion to the live. There is further an ambiguity in the stresses produced by a load on this panel. If we have one suspended panel loaded, the proportion of load that goes to the further abutment has two systems of bracing to travel on. It is customary to assume that half goes on each system, but this is an arbitary assumption and it is not certain that in some cases all of it may not go on one system. To be safe we should proportion each system to carry all of it. Still, it bears a small proportion to the total stresses and the error in the usual assumption is not large. In forms of trusses having intermediate or sub-panels suspended from the intersections of two systems of bracing, this ambiguity is multiplied and becomes a serious fault.

The evolution of the end panel construction shown in the Whipple strain sheet has been as follows: The rods or eye-bars were replaced by a stiff suspender in order to reduce the vibration. The stiff bottom chord was introduced to prevent the buckling of the bottom chord from the thrust of a derailed train on the bridge or collision with the end-post. It also acts with the stiff suspender to prevent the end panel point being raised, as by drift, and thus pulling the span off the pier, which might be done with a comparatively small force on account of the small chord strain in these end panels. The end-post strut was introduced to stiffen the end post and to prevent its destruction by a blow from a derailed train. Its office as a stiffener to allow of a higher unit stress in the end-post is of very questionable value as will appear when we consider that most of the strain in the end suspender (80 per cent. in the 255 ft.-span) comes from the live load and its impact on *one* panel and the application of this load will cause a very considerable fall of the panel point through the stretch of the suspender and through the end-post strut produce flexure in the end-post. This disturbing influence may take place when the end-post is under maximum stress as when the head of the train passes on to this panel and the whole span is covered. The value of the end-post strut in enabling the end-post to more effectually meet a blow from a derailed train somewhat reconciles us to its use.

Now it will be seen that the curved chord truss has no "vibration panel" with its end-suspender, but in place of it a regular panel of the truss having the greatest vertical strength of any of the panels. The above objections to the end post strut do not hold with the same force because the ties supporting this panel receive their maximum stress when the end post receives its maximum, in fact they act together throughout and reduce the disturbing effect on the end post to a very small amount. The end stiff chord covers but one panel, and is less needed both on account of the greater strain in the end panel and the greater resistance to the upward force of drift, supplied by the web members at this point. The curved chord bridge is better prepared to resist a blow from a train through its shorter and more inclined end post.

In the *deck* Whipple the end suspender consists of two rods to carry the weight of the bottom chord panel. This panel point is evidently not prepared to resist upward forces or weights falling from above. The chances of these occurring are so small that the additional expense of a large stiff suspender, which would give greater security, is not usually incurred.



A New Bridge Truss; Through Railway Bridge.

This panel in the new curved chord truss is the strongest in the bridge.

The curved chord trusess, both deck and through, are better calculated to resist the *wind* than the Whipple. They have less area on account of the longer bottom chord panels. In the deck span the overturning force is much smaller than in the Whipple as the distance from the train to the masonry is less and the part of the truss below the level of the supports tends to counterbalance that above.

In the through curved chord bridge the curved lateral system distributes the resistance to overturning throughout the length of the span and brings the lateral strains down nearer to the masonry at the ends where they can be taken by small portal struts. Such a bridge would evidently have considerable vertical stability without portal bracing, whereas in the Whipple the laterals are carried horizontally to the ends where the total overturning effect must be resisted by large portal struts.

The temperature effects in trusses of all forms properly constructed will not differ greatly, but where the bottom chord is sheltered from the sun, as is often the case, the curved chord might be less affected through the greater freedom with which an arch will rise.

The curved chord truss has an advantages over the Whipple in the steeper inclination of the diagonal ties and over bridges with triangular bracing, in having no members subject to reversed strains, *i. e.*, alternating tension and compression. Experience has shown that it is motion rather than stress that causes wear. In triangular (Warren) trusses taken down after having been in service several years, the pins and pin holes in the web

members near the middle of the span, which are subject to reversed strains, show *very* much greater wear than any other parts. The pin hole has of course a little play to begin with and a hammering action is produced by the alternating strains in the piece, elongating the pin hole, which elongation is itself an element of destruction. This fact has led to the abandonment of the Warren girder in many cases.

The objections to pin connections, which have been made by English engineers, are largely founded on the experience with the Crumlin viaduct, where it was necessary to replace the pins with riveted joints owing to the wear and consequent play in the joints. This wear has been attributed to the small size of pins used, but was no doubt largely due to the alternating strains in the tie-struts of the Warren girders.

This trouble seems to be quite avoidably in the use of adjustable counter ties. When these rods are provided with a small initial stress by adjustment, the stress passes from the main ties to the counters without any lost motion or hammer-blow effect, and the means of adjustment enables the posts to be always kept in close working contact.

BEAUTY.—We cannot prove by figures and reasoning that one thing is more beautiful than another, of this quality the eye alone must be the judge. Opinions will vary greatly and in our efforts to determine the probable judgment of the best minds we must be guided by general principles deduced from a study of those things recognized as beautiful, just as the principles of rhetoric are deduced by observing certain common qualities in the diction of our best writers.

The elements of beauty of form are, truth, unity, symmetry and individuality. By *truth* we mean fidelity to the principles of nature and fitness for the purpose. Whether from training or naturally orderly instincts, the eye is pleased with forms best conforming to mathematical law. It seems to be dissatisfied without a reason for the form and condition in which a thing is presented to it. A post to support a load must be straight and plumb. The arch and suspension bridges are the most beautiful. They are in the strictest conformity with natural law.

A form to be beautiful must have a *unity* of design, so that the eye can determine when it is complete; not like a ladder which might be indefinitely extended, but rather like a circle from seeing part of which a conception of the whole is formed. The parts must bear some definite relation to the whole and be really necessary to its completeness and their relations readily grasped.

All regular geometrical figures are beautiful and this they owe largely to their *symmetry* which as an element of beauty requires no comment. *Individuality*, though sometimes violating the strict principles of beauty, is generally pleasing. It interests the attention with "something different," and when accompanied with the quality of "newness" has often a much greater charm.

It is believed that the new form of truss presented is more beautiful than most others. The curvature of the chord, the gradually increasing inclination of the posts, bearing as it does a definite relation to the curvature of the chord; and the unity of design, contributing to that result.

ERRATA.—In our last issue on page 414 in formula (2) for $v^2 + l^2 + p^2 + b^2$, read $v^2 + l^2 + p^2 - b^2$. This correction is very important.

WAVE POWER.—In a paper lately read by Mr. B. HAUGHTON, before the Civil and Mechanical Engineers' Society of London, the author gave the following notes on wave percussion: At Wick, a mass containing 1,500 cu. yds. of cement rubble, weighing 2,600 tons, was carried away. On another occasion the piece which fell under the blows weighed 1,350 tons, and waves have been known to rise to a height of 150 ft. at Wick. At Dunbar, dynamometer tests of wave pressure showed 3⅛ tons per sq. ft., and the average winter pressure was 0.93 tons. At Zetland, blocks of rock weighing 9½ tons have been quarried out of their beds by wave action, although 80 ft. above high water.

New Rochelle, N. Y.—A bill has been drafted authorizing the construction of a sewerage system, and the issue of $200,000 bonds to pay for it. The scheme is being vigorously pushed.

A New Method of Stocking and Reloading Coal.*

The Conveyors employed for this work are of two varieties: The first, called the Flying-Extension, consists of an endless chain, to which are attached flights or scrapers, forming a chain conveyor, at the lower end of which is a sprocket wheel situated under the railroad track, and the other end passing around a traction wheel secured at the upper end of a pole, which is held in an upright position by suitable guys. (Figs. 1 and 2.) The conveyors of this kind, which are now in use, are about 150 ft. long, with the upper end located from 50 to 75 ft. above the ground. The scrapers are 8 in. × 20 in. in size, and are placed at intervals of 2 ft. on the conveyor chain. There is no support for the lower strand of chain between the foot and head wheels. The upper strand is supported on idler wheels at intervals of 50 ft. These wheels are either suspended on wire cables or supported by light trestle work, if convenient. The province of the flying-extension is to take coal from the dump situated above the lower end, and convey it towards its head wheel, thus forming a pile of coal, and general shape of which is conical, with the apex under the lower strand of chain, and if the conveyor is fed until it has conveyed coal to its upper end, the apex will be directly under the head wheel, forming a pile, say 65 ft. high and 300 ft. across its base and containing about 20,000 tons. The pile of coal so formed is in the best possible condition to be reloaded, as there is no trestle work or other timber obstruction, excepting the pole in it.

In the event of it being advisable to use the same apparatus at another place after its having built one pile, the only portion remaining in the pile would be the pole, the value of which would be about $15. The apparatus described has a capacity of about two tons per minute, and this could be increased almost indefinitely, if required. It is difficult to make a comparison between the cost of stocking coal by this method, and the ordinary plan for using hand labor after the space under the trestle has been filled up, because it is practically impossible to make such immense piles of coal by hand. The average cost, however, of stocking coal on either side of a trestle to a distance of, say 20 ft., is about 30 cts. a ton, whereas the cost for stocking coal with the Flying-Extension is but a fraction of this amount. There are four of these conveyors now in use at the wharves of the Philadelphia and Reading Railroad Company at Port Richmond, Philadelphia, and others in process of erection.

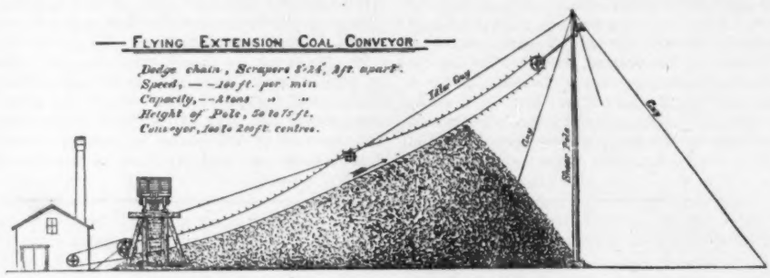


Fig. 1.—Stocking and Reloading Coal.

For reloading the coal into cars after it has been stocked, a conveyor is used which is so constructed that it may be moved sideways toward the base of the pile, and kept running continuously while it automatically attacks and conveys the coal toward the trestle from which it was originally dumped, at which point it discharges the coal into inclined conveyor which elevates it to a loading-pocket, from which it is tapped into cars. The reloading conveyor is so constructed that it can be swung to the right or left, and is capable of operating on either side; consequently by locating it between two Flying-Extensions it would be able to reload the coal stocked by either of them. By means of the Flying-Extension and reloading conveyors it is possible to store immense quantities of coal on vacant land at some distance from the sea-coast, and cheaply reload it and deliver it at tide-water as called for, instead of storing coal under expensive trestle work and upon valuable dock property.

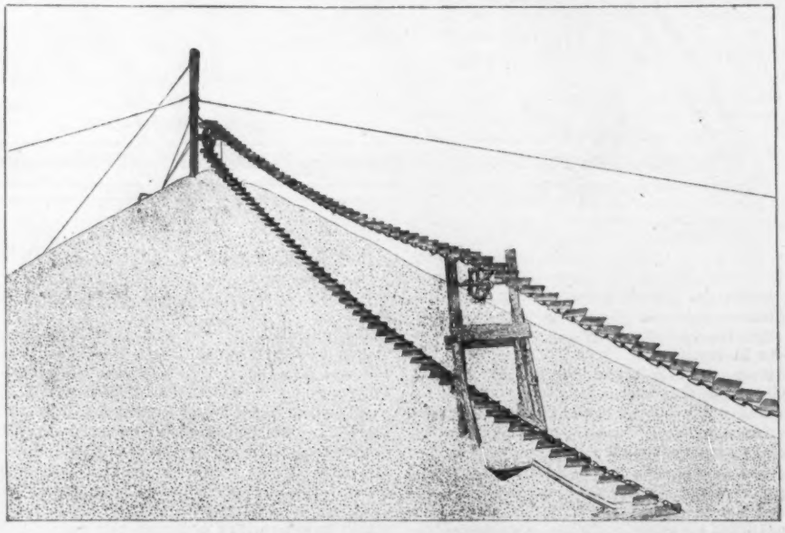


Fig. 2.—Stocking and Reloading Coal.

*By James M. Dodge, Philadelphia, Pa. Presented at the XVIth Meeting, Philadelphia, 1887. American Society of Mechanical Engineers.

ANOTHER cave-in of the Swannoa tunnel in the Blue Ridge mountains, North Carolina is reported. The tunnel is on the Richmond & Danville Railroad. It is half a mile long and its greatest depth below the summit is about 300 ft. Numerous falls have occurred, and the work of lining the tunnel with brick has been in progress for some time. The reporter of a daily paper says that "prominent engineers" state that the tunnel must be converted into an immense open cut. If, however, the tunnel is of no use as a tunnel, why not choose some other route in preference to a cut 300 ft. deep.

The Dalrymple-Hay "Curve Ranger."

We are sure that American engineers will examine with great interest and admiration this refinement of English field practice, which we find illustrated in *Engineering*. That journal states:

"Messrs. Elliott Bros., of 101 St. Martin's lane, W. C. are the makers, and their name is a guarantee of good workmanship, just as that of Mr. HARLEY H. DALRYMPLE-HAY, the designer, is of the theoretical accuracy of the instrument."

American engineers heretofore have been obliged to content themselves with a common transit for "curve ranging," and when they wanted to run a 1° curve they have been compelled to set their vernier at 30', 1°, 1° 30', 2°, etc., in succession, and similarly for other curves. Sometimes they have even been obliged to set the vernier at such odd figures as 1° 35' or 2° 16' to suit odd degrees of curvature or fractional stations. This not only involves a confusing strain on the intellect to set the vernier, but a still more decided disadvantage if the ranger does not know how to read the vernier. It is also open to the objection that it compels all kinds of linear work to be done, with very unscientific simplicity, aided by only one instrument.

These disadvantages are aggravated in English practice by the fact that their curves are all of odd

The Dalrymple-Hay "Curve Ranger"
(From *Engineering*.)

degrees, since they are made of an even number of chains radius instead of even deflection angles. In addition to the vernier disadvantages therefore, it is necessary to hunt through a table for the proper deflection angle, or even in extreme cases to compute it trigonometrically with still more attendant trouble and danger of error.

All this is saved by using the ordinary theodolite for ordinary linear work and having this curve-ranger at hand, on the back of an assistant instrument-carrier, or at some convenient farm-house, when a curve is struck. By this instrument the only knowledge required to run any curve under however complex conditions is the ability to read a steam-gauge, which the "index" *h* closely resembles.

The instrument is operated by first "adjusting it to the required radius," then setting it up on the P. C. and fixing it on tangent, which is necessarily done from a foresight, and not by the common process here of flopping over the telescope, as this telescope is not made to flop. Then:

"The tangent screw is turned until the index *h* points to 1 on the scale behind it; and a peg is inserted on the line fixed at one chain distance from *A*. The index is then turned through another division, and a peg is driven at the next point one chain distance from the last. So the process is continued until the curve again *enters the straight portion of the line*. Hence it will be seen that the instrument does away with all calculation and converts curve ranging into a mechanical operation."

What is done if the whole curve cannot be ranged at a setting is not explained, but other details are, given in the following lucid manner:

"The essential feature of the apparatus is a roller *a* which runs in frictional contact with a table *f*. This roller is mounted on a graduated spindle *b*, at the other end of which is the index *h*. The roller is caused to rotate by turning the telescope stand, and the long arm projecting backwards from it, around a vertical axis by means of the screw *k*. As the arm sweeps over the table the roller is caused to revolve and moves the index, the amount of motion of the latter for a given angular movement of the arm, depending upon the distance of the roller from the center. Now the spindle *b* is graduated, the marks corresponding to radii from 20 chains to 100 chains, [52' to 4° 20' ED.] and the roller is set to the mark corresponding to the curve which is to be ranged. When it is at the extreme end of the table a very slight angular motion of the telescope will move the index over one division, and on the other hand, when the roller is at the inner end, the telescope must be turned a considerable amount to get the same movement of the index.

"*This ingenious device forms the key to the whole instrument*, which in its other features is very carefully designed. The various parts are clamped on to a central column by the screws *d*, *e*, and *g*, and when these are relaxed can be turned in any direction. The vertical axis of the instrument can be made to revolve by releasing both the clamps *e* and *d*. If the lower clamp *d* is secured, then the vertical axis can again be turned, but if both clamps are secured a slow motion can be given to the vertical axis by turning the tangent screw K. *g* is a clamp and *i* a slow motion screw for the horizontal table *f*.

"When this clamp is loosened the horizontal table can be made to revolve round the exterior of the fixed socket, but on tightening the clamp a slow motion can be given to the horizontal table by the tangent screw, *i*. There is slow motion gear for moving the telescope in altitude."

Engineering continues that "the instrument is mounted on a tripod of the ordinary kind," so that there is nothing new to learn about that, and that for sharper curves than 20 chains radius the index readings are multiplied by 2 or 3. "For instance, for a radius of 18 chains the instrument is set at 36 chains and the index made to pass over two divisions to each observation instead of one."

Thus the making of observations by this instrument is under all conditions a very simple matter, however many observations a curve may require, unless, indeed, it happens to be less than 52', which seems a difficulty, since it would require the index to be subdivided into fractional readings to run the curve and thus introduce some of the embarrassing complications of the ordinary vernier. As the whole arc of the table seems to be hardly more than 10°, there might appear to be difficulty in running any considerable distance at one setting, but this (we assume) is overcome by moving the roller and index back to zero, and taking a new sight on the last chord to start from. In working at intermediate stations where the angle between adjacent chords may be considerable, this would be particularly troublesome, but by laying not over 10° or 15° at a time and taking a fresh observation each time all conditions may, no doubt, be met. What is to be done if the weather happens to be dusty or misty, or there is snow falling, or the "ranger" happens to be "sweating away at the brow" and thus moistens the roller or table we do not know. The curve-ranging perhaps is stopped under those conditions.

We have, perhaps, given more space to this precious instrument than it deserves, and only do so because it has a certain adventitive interest as an indication of the advanced condition of English field-practice. That it should have been possible for anyone to either design or manufacture it or describe it in an engineering journal is a fact of no slight significance.

The Effect of Temperature upon Structural Iron and Steel.

(*Continued from page 427.*)

DISCUSSION.

A MEMBER: Mr RAMSEY has presented a paper to us which is bristling full of interest to engineers and to the traveling public. I tested some iron myself a few years ago, and the iron I see presented here to-night is of such character that looking at one end it appears to be all it ought to be, and such that I, in my inspection, would pass readily as fulfilling the specifications of the railroads I was inspecting for, and yet it might go into bridges and be subjected to tests similar to what these bars were subjected to and prove defective. Now the question is, are inspectors getting the iron for bridges, or the railroads who have erected bridges, that they ought to have? The question is not, what the quality of the iron should be, if it stands the physical tests but it does raise the question as to what the chemical tests of iron should be in order to stand its physica tests at the different temperatures.

Mr. BECKER brought the question forward that I was going to suggest to Mr. RAMSEY, that he ought to have continued with these experiments and tests with iron low in phosphorus, to see whether these facts will carry out under the low temperature. It is a question of vital importance, and although I am out of iron inspection at present, it is a question to me of life and limb.

As far as steel rails are concerned, I also, in 1877, inspected rails for the New York Elevated Railroad, to test same for transverse strength. At that time the road was going to use a spike-notched rail. The question was raised at the mill whether that was the correct thing to put in a place where life and limb was so very much at stake as in New York City, and it was suggested that there was a great deterioration in the strength of the rail, and I said that I would like to test the matter. Facilities were placed at my disposal, and we took rails and cut them in two, spike-notched at one end, and tested them, and if I were to tell you the percentage of deterioration of the spike-notched, it would be hardly credible. I have not the figures with me to-night, but it was alarming.

I carried the experiments far enough to report the results to Mr. KATTE, and he immediately ordered the rails not to be spike-notched. I carried the experiment still further to see what effect mechanical defects would have upon the rail, as, for instance, the chisel mark, and I found that had a wonderful deterioration. Then I went still further. I scribed the rail with a scribe, so as to leave a mark you could see, and to my utter surprise that had a great effect, so much so, that with the drop test the spike-notched rail would fail at possibly 6 to 8 ins. drop with a 1,000 lb. weight while the other portion of the same rail between supports, 2 ft. centers, would, with repeated blows of 10 ft., bend but not break, showing a very marked deterioration in the spike-notched rail. The same was carried out even in the mere mechanical scratch.

Now, as regards breaking of the rail in the track in cold weather, it has been suggested by some engineers that it may be due to the ballast. These mechanical defects may exist in the rail and not develop in a springy road-bed, that is, not solid and rigid in cold weather. When the cold weather comes on, the road-bed is in the shape of an anvil, and these mechanical defects are apt to show themselves more than at any other time. It may be in the handling of the rail, it may be in throwing the rail off the car, or it may be due to a sliver in the rail, or some indentation, and this may occur even after the rail has been laid a number of years. The experience I had in that matter leads me to believe that any scratch is apt to show itself. If Mr. METCALF were here to-night he would probably tell you that in making the rams or pistons for his steam hammers, as for instance the one we spoke about at the last meeting, he showed me a very fine finish that he put upon his rods. I asked him what the necessity was. Well, he said, his experience was, that when a rod was marked with a tool, or had a tool mark left on it, it almost invariably broke before the time it ought, and almost invariably broke where the tool mark was. When he finished the rods for his 10-ton hammer he took out every tool mark and finished the iron carefully, expecting that would relieve it in a large degree from this starting of a break. In that way I account for the breaking of steel rails more in winter than in summer, due to the solidity of the road-bed forming an anvil for the already defective rail.

Mr. HALLSTED: I have lately made several tests, freezing tests, of 2¼ × 2½-iron chiefly, with the phosphorus running from .25 per cent to .05 per cent. I could find no material difference as regards the percentage of crystal, but the crystalline fracture seemed to be finer in the low phosphorus, but in the whole number of bars the percentage was about the same. In regard to the requirement of freezing tests, Mr. VAUGHAN, of the Louisville Bridge & Iron Co., and Consulting Engineer of L. & N. Ry., has for several years required them, though it is not mentioned in his specifications. We have made them for him for some time.

Mr. OSBORN: I do not think he requires it in the L. & N. specifications, but it has been his practice since 1880, that at least one bar in every eight or ten should be tested with the nicking and bending test, making it over an anvil with a sledge.

Mr. DEMPSTER: So far as we have gone the evidence is rather of a negative character than positive. I do not see how you can decide such matters until you have made tests of a steel rail at a low temperature and similar tests from same lot of rails at a normal temperature. So far as the breakages are concerned, so many things may operate to cause them, that, after all, it is only negative evidence that has been presented here to-night.

TO BE CONTINUED.

Water-Works at Calcutta, India.

The contract for the construction of the works was awarded in December, 1866, by W. SMITH, Chief Engineer, to Brassey, Wythes, Aird & Sons, for $2,375,000, and work was commenced in January, 1867. The laying of the 42-in. iron main was completed by July, 1869, but it was not deemed prudent to apply the contract test of 100 ft. head. It was considered quite safe at 40 ft. head, and was accepted in December, 1869, and opened May, 1870. Since that date the city has been supplied with filtered Hooghly water from Pulta. In 1871 it was proposed to increase the supply from 6,000,000 to 12,000,000 galls. per day. In 1872 a new 75 H. P. engine was put in, and in 1874 another 75 H. P. engine was added, and the old abandoned Chandpaul water-works were revived for watering the roads. In 1876 4 new filters were added to the 8 already built at Pulta; these were 200 by 100 ft. In 1879 the daily supply averaged 7,500,000 galls., the limit of the works, and an additional supply became necessary. Plans were prepared by JAMES KIMBER, M. I. C. E., Chief Engineer of the Municipality, and it was decided to lay a 48-in. iron main, with a daily capacity of 12,000,000 galls.; work was started in 1883. Additions were also made to the works for the unfiltered supply, increasing the capacity to 2,000,000 galls. per day.

Up to the end of the financial year, 1884-1885, the total expenditure amounted to about $4,500,000. For this sum, the Commissioners give the following account: Main works at Pulta, consisting of 3 50-H. P. beam pumping engines; 6 settling tanks, each 500 ft. long by 250 ft. broad by 7 ft. deep; 12 filters, each 200 ft. long by 100 ft. broad; a 42-in. cast-iron main, 12¼ miles long, capable of delivering 8,250,000 galls. daily into a covered reservoir of 1,000,000 galls. capacity at Tallah; 4 beam engines, 3 being of 50-H. P. and 1 of 75-H. P., pumping from the Tallah reservoir into the mains of the northern division of the town during the day and at night into a covered reservoir, holding 6,000,000 galls., at Wellington square. There were 118¼ miles of street pipe, from which filtered water was taken at 571 public stand-posts, numerous ground hydrants and cattle troughs, and 15,869 connections with private premises. For the unfiltered water-supply, 34¼ miles of streets have been piped, pressure being maintained by 2 50-H. P. horizontal engines. Only in very exceptiona cases is this unfiltered water laid on to private premises, either for business or domestic purposes. It is used for watering the streets, public latrines, flushing the sewers, and the bathing platforms, until the extension works are completed, when these latter will be supplied with filtered water.

The present population is 401,000, and the shipping brings this up to 430,000; the total population to be supplied, including the suburban limits, is 680,000.

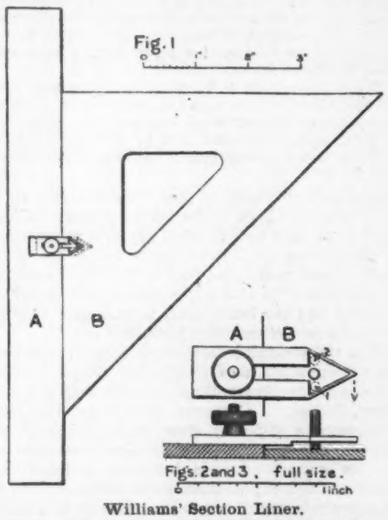
New works are under construction and contemplated, under the supervision of Mr. KIMBER. His plans secure an ample supply of pure filtered water at the head works, and convey it thence to Tallah. In the town, pumping power will be added and new mains laid down, as the demands for water increase and the Commissioners find themselves in a position to incur the outlay. The extension works consist of a new engine-house at Pulta, containing four sets of compound engines of 175-H. P. each, pumping into 2 settling tanks, 2,000 × 258 × 10 ft. The new main was inaugurated in March, 1886; it will convey about 12,000,000 galls. per day by gravity, or 24,000,000 by pressure at the pumping station. In August, 1886, another 75-H. P., engine was erected and the city is now receiving 10,000,000 galls. of filtered water per day.

Of the 4 sets of engines for which the works are designed 3 have been contracted for by Fawcett, Preston & Co., of Calcutta. They are direct acting, vertical (inverted cylinder), compound, intermediate receiver engines, working with a large grade of expansion from a boiler pressure of 90 lbs., the contract obligation being to lift 16,500,000 galls. 40 ft. high in 10 hours. The cranks are at right angles. The high pressure cylinder is 27 ins. diam. low pressure, 45 ins.; stroke 48 ins. Both cylinders are fitted with piston valves, and the high-pressure cylinder is provided with a separate expansion valve working inside the main valve, arranged so that the grade of expansion can be readily altered while the engine is at work, by partly rotating the expansion valve spindle. The crank-shaft is of mild steel, and is fitted with a heavy fly-wheel in the center of its length. The main pumps, of which there are two to each engine, are placed one under each cylinder and are driven direct by side rods from the engine crosshead. The surface condenser is placed in the suction main, and is arranged so that the whole of the water pumped by the engines acts as the cooling medium. There are 6 cylindrical, double flue boilers, 7 ft. diameter by 28 ft. long. They are of mild steel and work at a pressure of 90 lbs. per square in. The works are very complete and well designed and built, reflecting great credit on the engineer, Mr. KIMBER.

The above is condensed from articles in *The Indian Engineer*, of Calcutta, India.

Williams' Section Liner.

The little instrument which we illustrate, manufactured by Messrs. Keuffel & Esser, of this city, is one which is deserving of wider use by draughtsmen who have much sectional lining to do; and still more by those who only have to do it occasionally, since they lack the skill of hand which sometimes enables a practical draughtsman to do marvelously even work by the eye alone. Its use is in principle simplicity itself. The triangle *B* has a little pin set in it, and the straight-edge *A* carries a set-screw which fixes the arm carrying the triangular slot. According as this arm is set to project more or less over the pin the free motion which the triangle may have when slid along the ruler is varied, and first the ruler and then the triangle is slid through this distance, giving exactly parallel lines.



Williams' Section Liner.

It requires some practice to do this rapidly and surely, but it is not really difficult to do it with one hand, the other holding the pen. There is another make of a somewhat similar but more elaborate mechanism, Casey's, which accomplishes the same end, with the advantage that it carries a vernier for setting the instrument to space the lines at a given fraction of an inch apart, and there is also the in genious Blunck instrument which moves the ruler by pressure, but in simplicity, at least, the instrument we illustrate is the best, and it will do ex cellent work. The relative prices of the instruments mentioned are $3.50, or $4.50 and $5.00. They are deserving of wider use.

A valuable use for this instrument, apart from that of section lining proper, is for drawing street lines, and such like work, at exactly even distances apart, a detail which has much to do with the appearance of a map, and in which many draughtsmen are very weak.

M. de Lesseps' View of the Panama Situation.

The following letter of M. de LESSEPS is translated from the *Bulletin du Canal Interocéanique*, the official organ of the Canal Company, and gives the present situation from the companys' standpoint; it is addressed to the President of the French Republic.

PARIS, Nov. 15, 1887.

MR. PRESIDENT:

The Panama maritime canal, as voted for by the International Congress of 1879, should have cost 1,200,000,000 *fr.* ($240,000,000) and have been finished in 12 years, and have secured a traffic in the first year of use of 7,500,000 tons. It was possible to finish the canal in 8 years by doubling the material, which latter has been done. But this material meant the accumulation of 30,000 or 40,000 workmen, and we had hoped that our contractors could procure them.

A traffic of 7,500,000 tons assured at 15 francs ($3.00) per ton, and independently of all accessory revenue from 500,000 hectares of land, pilot-tax, towing, etc., would return an annual revenue of 112,500,000 f. ($22,500,000).

In its estimate of total expenses the Congress figured that the necessary loans could be placed at 80 per cent. But the interference of adverse financiers have prevented the realization of this hope. On the other hand the fears of certain contractors have made them lose precious time by their hesitation, and the date of opening the canal, at first fixed for 1888, should be postponed one year, or to the end of 1889. To be sure of this, as the end of the year is in the rainy season, we will admit that the inauguration of the canal can not take place until the first month of 1890. The cost of d'gging the canal proper is not increased; but the annual charges resulting from the last loans add each year to this total cost.

In spite of the rabidness of adversaries I am decided, as I have promised the stockholders for 2 years past, to open the Panama canal as I have already opened the Suez canal under identical circumstances: that is to say, with an annual traffic of 7,500,000 tons, to open a sufficient passage and to reserve for the future the completion of the canal from annual revenue, as at Suez.

The loan, and other charges imposed upon the Company in the execution of the canal, give the following as the actual situation:—

Capital shares	300,000,000 fr.
Loans authorized and realized	635,000,000 "
" " "	265,000,000 "
Charges imposed by increase on the estimate of the Commission	300,000,000 "
Total actual cost of the canal on the opening day in 1890	1,500,000,000 fr.

The receipts from 7,500,000 tons—112,500,000,000 fr.—would leave after deducting 60 per cent., or 72,000,000 fr., a sum of 40,000,000 fr. ($8,000,000) to meet the following expenses:

1. Administration expenses	5,000,000 fr.
2. Maintenance	6,000,000 "
3. Interest on 50 per cent. of the capital stock	15,000,000 "
4. Contingencies	4,000,000 "
Total	30,000,000 fr.

This would leave 10,000,000 f. to be distributed as a first dividend.

These facts being established, it only remains to assure the carrying out of the programme. The Chief Consulting Committee of the company having been convened the two questions following were submitted to it.

A. Is it possible to establish on the central ridge a summit-level canal which will permit the continuation of the work on a sea-level canal by dredging, etc?

B. Will it be possible, with this arrangement realized, to open the ship canal to traffic between the two oceans without interrupting the work of deepening the canal?

The consulting committee in full session answered these questions unanimously in the affirmative. This new plan approved leaves us only 40,000,000 c. m. of material to remove; of which 10,000,000 c. m. is in hard material and 30,000,000 c. m. in dredgable earth.

This material reduction in work being assured, we have confided to M. EIFFEL, a well trained and bold engineer, the design of the special engineering work required. This morning M. EIFFEL has engaged himself to execute these works, at his own risk and peril, on conditions favorable to the company.

It only now remains for the Government of the Republic—since the French law obliges us to address to it our request—to assure the definite execution of our programme, by authorizing the Canal Company to raise further funds by a lottery.

I have the honor, Mr. President, therefore to demand this authorization: For the 265,000,000 fr. which remain to be issued on the 600,000,000 authorized by the share holders; for, the 300,000,000 fr. which will be necessary up to 1890, and eventually for all or part of the loans already issued, the conversion of which will be optional with holders.

I put at your entire disposition, Mr. President, and also for the use of the Parliament, all contracts and documents actually in our hands and by which the execution of the proposed programme is assured.

Be pleased to accept, Mr. President, my respectful compliments. FERDINAND de LESSEPS.

President Director

Examination Questions of English Sanitary Inspectors.

The state of mind of an average Sanitary Inspector of this city can perhaps be better imagined than described were the following questions put to him as a test of his fitness for office. These questions are taken from the London *Architect* as given out at the last examination of candidates for the certificate of the Sanitary Institute.

Sketch the proper method of draining a town house, say 20 ft. frontage and 35 ft. deep, the w. c. and scullery being at the back, and the main sewer in the front street. Describe the materials and sizes of the drains, the method of ventilation, the sizes, positions, and descriptions of the traps, and of the internal sanitary fittings. In what way does the size and shape of a sewer

affect the velocity of the sewage flowing through it? If a 12-in. pipe sewer, laid at a gradient of 1 in 175, gives a velocity of 3¼ ft. per second, what would be the velocity if the sewer had a gradient of 1 in 700 (the pipe running half full in each case), and would this latter velocity suffice to keep the sewer clear of deposit. Describe the conditions to be kept in view in selecting a source of water supply. Make figured sketches of the plans and sections of a dwelling-house four stories in height, including basement, and showing the proper thickness of the walls if built of brick. What are the points to be considered in providing efficient ventilation? Give examples, with details, as to size and arrangements for sleeping rooms, living rooms, workshops, public buildings. Describe by a sketch of the road and footways the best transverse section of a macadamized and of a wood-paved road or street 40 ft. wide, and give enlarged sketch, to include channels and gullies. Describe three modes of disposal of sewage and the advantages and disadvantages of each. State the circumstances which should lead to the adoption of a particular method. Find the cubical contents of a room 14 ft. 9 ins. in height, with a bay window 9 ft. 3 ins. high, and on plan a semi-circle 8 ft. diameter, and a bay window 10 ft. 9 ins. high, and on plan a semi-octagon 10 ft. diameter. In addition were questions relating to the legal and administrative aspects of a surveyor's office.

Laying Pipes Under Embankments.—The pipes being laid as in ordinary trenching, are bedded in concrete extending so far up as to insure that any settlement of earth can leave no vacancy. At each joint the irregular excavation of the bowl hole is continued by widening the trench to the top. The trench is made with rough, sloping sides. A mass of concrete is placed around each joint, filling the bowl hole and extending to the top of the pipe at its center. The filling is done in the usual manner, but with great care in tamping; valves are placed outside.

The Syphon well is built with a wrought-iron ring 30 ft. in diameter and 20 ft. deep. At the bottom are 48 cast-iron brackets, riveted to the shell and supporting a wooden platform 8 ins. thick by, from 24 to 30 ins. wide; on this is built a brick wall 30 ins. thick, extending to the top; in the center of its height, four 12×12 timbers are crossed, anchored to the iron shell and built into the brickwork. It was sunk by excavating inside, and it was intended to put in a bottom of concrete. It developed, however, a water flow of 500 galls. per minute, and followed by inflow of quicksand. The excavation was completed under water, and a diver employed, who built a wooden bottom of 2×12 in. plank, the ends extending under the wooden shelf, and each plank thoroughly spiked to the one next it. These being on edge form a bottom 1 ft. thick, thoroughly secure in every particular. Few divers have the mechanical skill and ability to do the work done by Mr. WM. OWEN, of St. Louis, on this work, and his subsequent death from injuries received in diving in the Mississippi, is a loss not easily replaced.

The pumps are provided with vertical check valves in their suction pipe, the valves are so arranged that they can be held up for usual work, being used as stop-valves when back flow is taken from the basins. The pumps, built from the writer's designs, are insets of four single acting plungers, 25 ins. diameter by 48 ins. stroke. They are driven by compound condensing engines of the same stroke, working on quarters with intermediate receivers and poppet valves. The writer's designs for the engine were in outlines only. The details were made by the Holly Manufacturing Co., who built them; they are provided with surface condensers, and intended for a capacity of 10,000,000 galls. each, but run just as smoothly at a rate of 12,000,000 galls. and over. Their general arrangement is shown in Plate 10.

TO BE CONTINUED.

PLATE 9. KANSAS CITY WATER WORKS

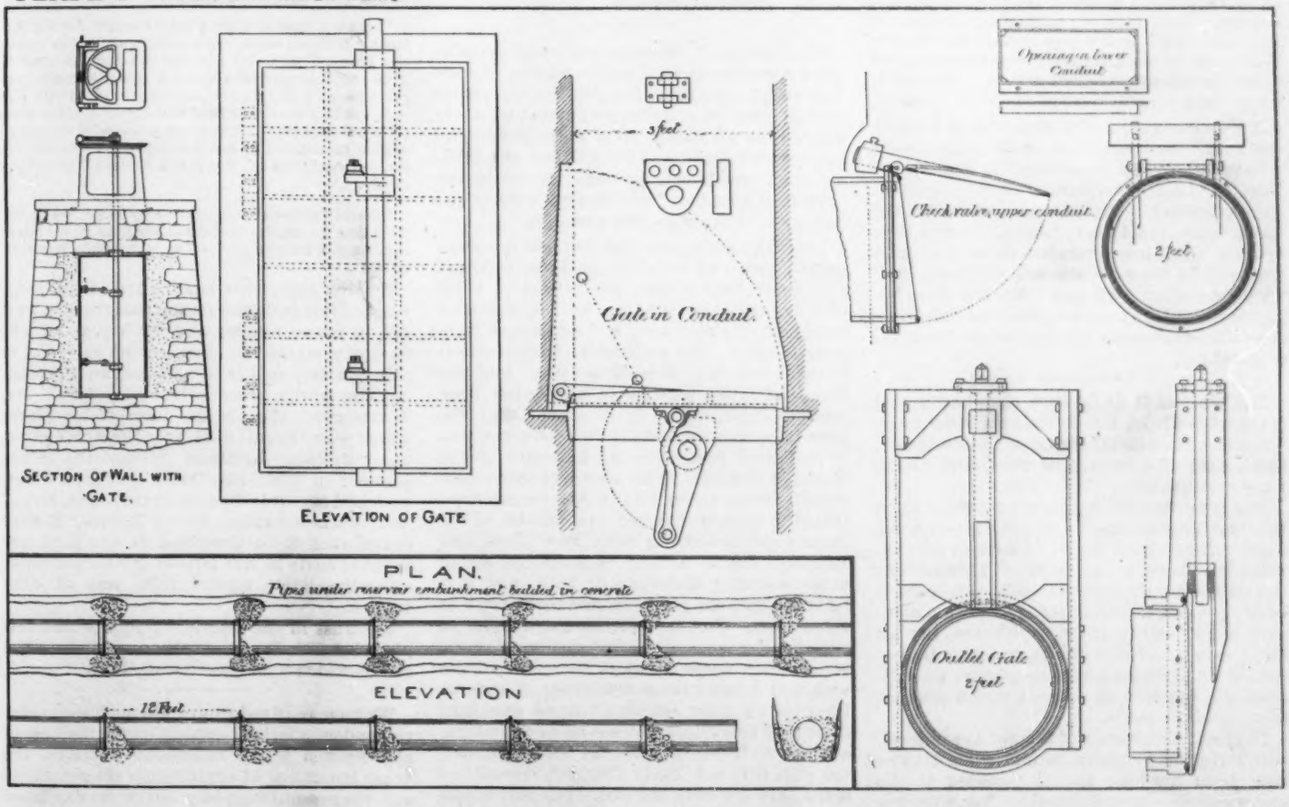


Fig. 9.—Kansas City Water-Works; Gates, Pipe-Bedding, Etc.

The Water-Works of Kansas City.

BY G. W. PEARSONS, CHF. ENG. NATIONAL W. W. CO.

Continued from page 400.

Gates and Valves.—The wall conduits requiring gates which could be contained within the wall section (those shown in Plate 9, were devised for the purpose); these, closing with pressure, and having to sustain but about 4 lbs per sq. in., are light. Their frames are built into the walls, and for handling them a 3½ in. steel shaft, carrying toggle arms, is controlled by a worm gear on top of the wall. When open the gate swings into a recess in the wall, the only obstruction to water flow being the shaft and its arms. The upper conduits are provided with check valves to prevent back flow; these are also very light and balanced. The outlet gates are opened from platforms, which are left bare when the water is drawn down by the pumps preparatory to cleaning the basins.

The Union Canal.

The Union canal, which was the first canal projected on the American continent, having been suggested by William Penn in 1690 and its route surveyed 70 years later, before there was a canal in operation even in England, is to be sold. The route of this canal was surveyed in 1762 by DAVID RITTENHOUSE, the astronomer, and Dr. WILLIAM SMITH, Provost of the University of Pennsylvania. It extended from the Schuylkill river, near Reading, to the Susquehanna, at the present site of Middletown, Dauphin county. It was the first link in a proposed chain of water communication between the Delaware river and Lake Erie, a project so gigantic for that early day, when canals and even turnpikes were unknown, that the projectors were believed by the people to be crazy.

RITTENHOUSE planned a system of inclined planes to overcome the Allegheny mountains, a plan which was adopted 75 years later by the State on its old Portage railroad.

The Revolutionary War interrupted work on the pioneer canal, and in 1791 ROBERT MORRIS, ROBERT FULTON, and TENCH FRANCIS became interested in it. The work was too far in advance of the times, however, and it was not completed until 1827. The canal is 86 miles in length, and some of the greatest engineering work of that day was necessary in its construction. The first tunnel in the United States was bored for this canal through nearly 800 ft. of solid rock, and the summit of the canal being higher than its terminal feeder, a pumping apparatus had to be constructed to raise the water to the necessary height. The canal cost $5,000,000. Railroad transportation having made the ancient waterway unprofitable, a few years ago it was abandoned, and it is now offered for sale. *Ex.*

ENGINEERING NEWS

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D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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A CORRESPONDENT calls attention to a slight error of the translator of the article on "Foundations and Dynamite," in our issue of Nov. 12. An examination of the original shows that in the first column of page 345, the translation should read: "and in the hole thus made a sheet-iron cylinder about 5 ft. long and 3½ ft. in diameter was *lowered* down, etc." This does away with any "forcing down"—and could be done more expeditiously, and time is a valuable element in this process of foundation making.

THE letter of M de LESSEPS, elsewhere given, is translated from the *Bulletin du Canal Interoceanique*, the official organ of the company, and presents the present situation from a company standpoint.

The only further comments to make upon the late radical change of plan is—that the future of the canal, by M. de LESSEPS own admissions, pivots upon a traffic of 7,500,000 tons per annum for the *first* year after this canal is opened; upon handling this traffic in a mongrel canal, and getting $3 per ton for all ships so handled, and finally, but most important of all, obtaining in some manner the millions still required to secure a streak of water from ocean to ocean.

The final excavation of the bed to sea-level, with the canal in operation and the bills to be paid from revenue, is not included in the above estimate of probabilities. For, with due respect to the worthy gentlemen of the Chief Consulting Committee, we do not think that their "unanimous affirmative" to the two very important questions put to them will have the slightest effect upon the mass of the Culebra.

Further, in assuming that the maximum tonnage figured for a sea-level canal can just as profitably be handled in a water-way that must lock up and down over a 300 ft. summit, M. de LESSEPS must either admit that the boasted advantages of a canal *à niveau* were much overestimated by the Inter-Oceanic Canal Congress, or that the facilities for handling ocean steamers in "temporary iron locks" have been much improved upon since 1879.

The financial statements in M. de LESSEP's letter are not very plain to an outsider and do not altogether agree with some previous statements. But as the whole future now depends upon the view taken of the case by the new President of the French Republic, who is himself a practical civil engineer, all figuring can be postponed for the present. M. SADI-CARNOT was not the candidate of the Panama Canal people, and it is just possible that they thought he would take entirely too professional a view of the situation and rule accordingly.

The whole Panama situation is a dearly bought lesson in the economic theory of canal location, and it is to be hoped that its teaching will not be lost upon the American canal-builders near by. In the case of the Panama canal there was entirely too much "trusting in Providence," and in the words of old Uncle TOM, "he war a very wuthless ole niggah, indeed." A great deal more preliminary survey and study of the problem on the Isthmus and much less "unanimous approval" of projects by an ornamental committee in Paris might have made a very different ending to the tale; and the result would either have been a proper ship-canal, or the saving of many millions of money to poor Frenchmen.

MR. CHARLES F. WINGATE makes an extraordinary statement in a letter which appears this week in the Brooklyn *Eagle*, in the rather caustic form of a statement, "that *in a city where some* 900 *houses out of* 1,200 *officially examined were found to have defective plumbing*, not very much can be said for either the 'practical plumbers' who do such work or the 'practical' inspectors who permit it."

It would hardly seem possible that in a community supposed to be civilized the italicized statement could be true, yet we have no doubt that in substance it is true, for the shameful defects of city plumbing are matters of common notority. The particular incident which brought out Mr. WINGATE'S letter was the illness of seven persons in one house from typhoid fever, where it appeared that the plumbing was shamefully defective, yet that it had been passed by an inspector of the Board of Health. From instances which continually come to our knowledge, we are compelled to believe that the sub-officials of the Boards of Health in both New York and Brooklyn are to a very large extent either incompetent or dishonest or both, and it is full time that the public should bestir itself in the matter. We could mention a number of specific instances of incompetence or worse which have come to us in an authoritative way, and besides these difficulties, so long as there is no more efficient control exercised than now over those who set up as plumbers, and are so licensed to spread death through the city, it is not likely that any amount of inspection can cure the evil. The public gets very much excited over great railroad accidents, yet it is certain that for every life lost by rail there a hundred or more lost by bad sanitary arrangements, and it seems impossible to stir up any effectual impulse to enforce reform.

THE St. Paul, Minneapolis & Manitoba Railroad has been trying an interesting experiment for avoiding snow drifts which is said to work very satisfactorily. Reliance is placed on changing the shape of the surface of the ground. The cuts are much widened, the ground hollowed out at the side, and the banks rounded off to blend into the natural surface. The result is said to be that the rounded side gullies serve as guides to the wind which whirls down into them and clears the cut of snow instead of filling it full. It is not yet fully determined that the process will be as effective in very heavy storms as in light, but even if it only serves in the latter it will be a great gain. So say the press accounts. Fences acting on the same principle have been invented and proved effective.

MR. JOHN B. JERVIS published a book called "Railway Property," in 1860, which we might well have referred to in discussing the origin of the locomotive truck last week, since it settles absolutely the whole controversy, if there can be said to be one where there is no room for doubt. Mr. JERVIS happens to quote in this volume in full a long letter of his to the *American Railroad Journal* in 1833, and published in Vol. iv., p. 468, of that journal, giving a very full account of how and why he introduced this then startling novelty,—and by the way, it is a significant evidence that American railroad progress was little behind and dependent upon English that there should have been at that time an "American Railroad Journal" two years old, which has continued to be published from that day to this.

Mr. JERVIS gives a long explanation of the whys and wherefores of the "Saratoga engine" which was "constructed by G. Stephenson & Co." and then adds:

> "I made a plan for a six-wheeled engine for the Mohawk & Hudson, *which was completed and put in operation* before I *made the plan* for the Saratoga engine This engine proved satisfactory, so far as regarded the principle of a six-wheeled carriage (one driving axle only was then used.—ED.] and was an important pioneer for the second plan. The superior ease with which this engine moved, led to the determination to alter the English engine on the Mohawk & Hudson" correspondingly.
>
> "Should further experience confirm what the operations thus far appear to warrant, the plan of the Saratoga engine may be revived as a valuable improvement."

Further experience has confirmed the judgment of this brilliant man in this respect, as it did in many others, and "the plan of the Saratoga engine" at once became universal in this country, as it is now becoming throughout the world. Just before the letter Mr. JERVIS gives the precise dates of his plans, which were the fall of 1831 for the first engine, the "Brother Jonathan" completed in the summer of 1832. He "then prepared a new plan and sent it to GEORGE STEPHENSON, Esq.," and the new engine, which Messrs. ROBERT STEPHENSON & Co. described as the first, was running early in the following summer (1833) when the letter quoted from was at once written.

We trust in the interest of justice and fair play that *The Engineer* will now withdraw the claims which it has heretofore made.

WE have received from a Massachusetts correspondent a letter complaining of the lack of appreciation of an engineer's services, the dense ignorance of engineering requirements and the general incivility too often exhibited by the selectmen and the committees on public works of the average small town in their dealings with the engineer in charge. In this particular case one of a committee of three selectmen asked the engineer to prepare plans for the abutments of a highway bridge crossing a railroad; the foundation was bad and the plans prepared were made with reference to the conditions of the case. Bids were called for and one received; but it was afterwards discovered that this particular member of the committee, who was a boilermaker, saw fit to call these bids on a plan of his own in which he had used the engineers' plan as a base but had rejected features that should have been embodied, and further failed to inform his brother committeemen that the plan was *not* the one submitted by the engineer. The engineer complains and says the margin of safety in the accepted plan is too low; but the work was started in a very loose manner as far as professional supervision, filing of bonds, etc. were concerned, and is now being carried out in defiance of the engineer's protest.

NEW FORM OF BRIDGE TRUSS.

DESIGNED BY GEO. H. PEGRAM. M. AM. SOC. C. E.

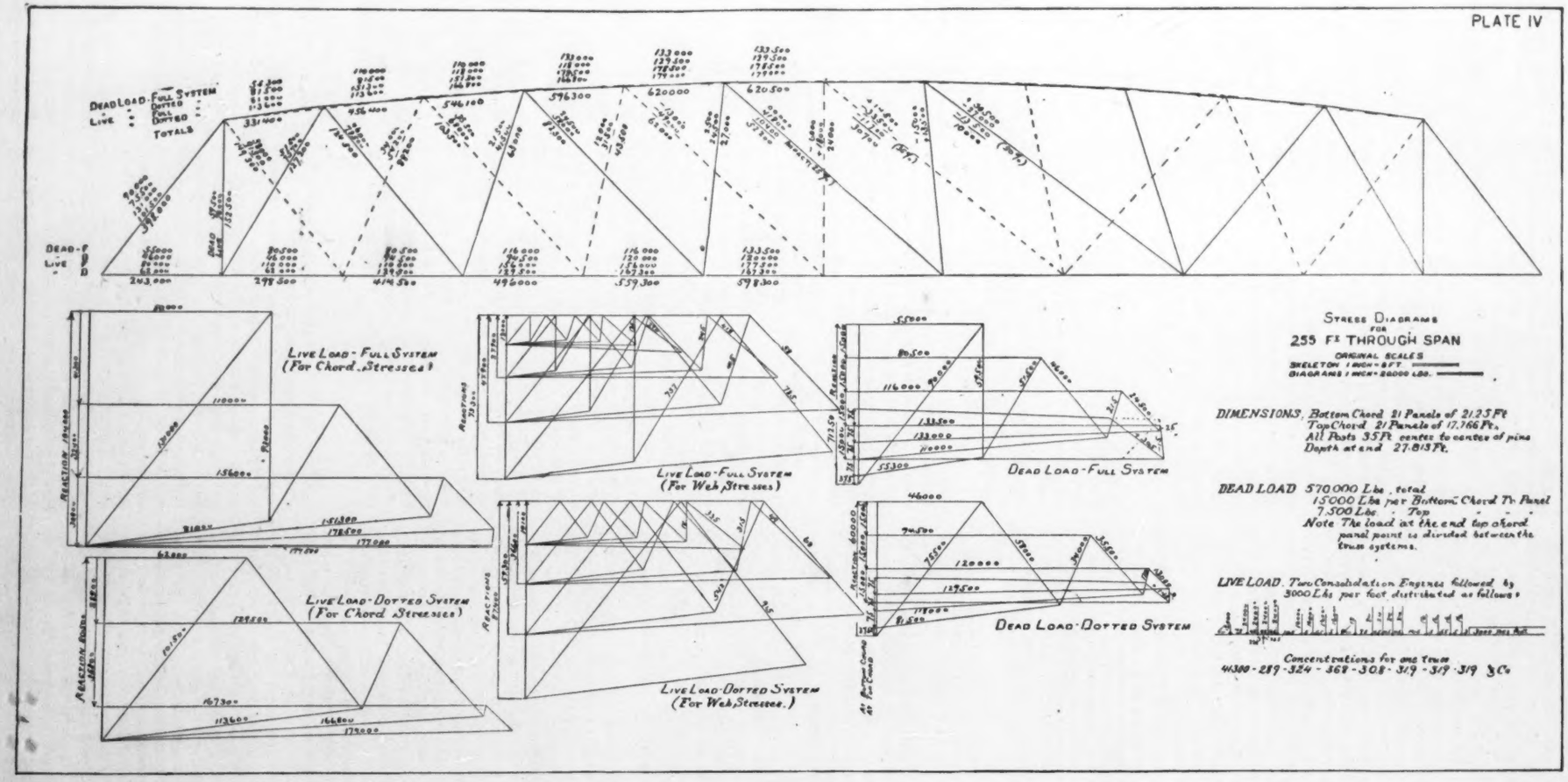
PLATE IV
Dead Load - Full System
Live " "
Dead " Dotted
Live " "
Totals
Live Load - Full System (For Chord Stresses)
Live Load - Dotted System (For Chord Stresses)
Live Load - Full System (For Web Stresses)
Live Load - Dotted System (For Web Stresses.)
Dead Load - Full System
Dead Load - Dotted System
Stress Diagrams for 255 Ft Through Span
Original Scales
Skeleton 1 inch = 8 Ft
Diagrams 1 inch = 20000 Lbs.
Dimensions, Bottom Chord 21 Panels of 21.25 Ft
Top Chord 21 Panels of 17.766 Ft.
All Posts 35 Ft centre to centre of pins
Depth at end 27.813 Ft.
Dead Load 570000 Lbs. total
15000 Lbs per Bottom Chord Th Panel
7500 Lbs " Top " "
Note The load at the end top chord panel point is divided between the truss systems.
Live Load. Two Consolidation Engines followed by 3000 Lbs per foot distributed as follows
Concentrations for one truss
41300 - 289 - 324 - 368 - 308 - 319 - 319 - 319 &c

PLATE IV.

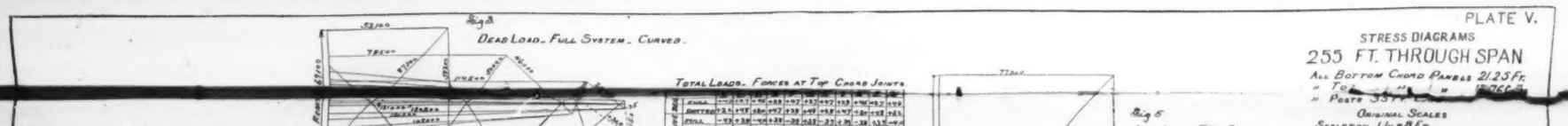
PLATE V.
Dead Load - Full System - Curved.
Total Loads - Forces at Top Chord Joints
Stress Diagrams
255 FT. THROUGH SPAN
All Bottom Chord Panels 21.25 Ft.
" Top " " " 17.766 "
" Posts 35 Ft. " "
Original Scales

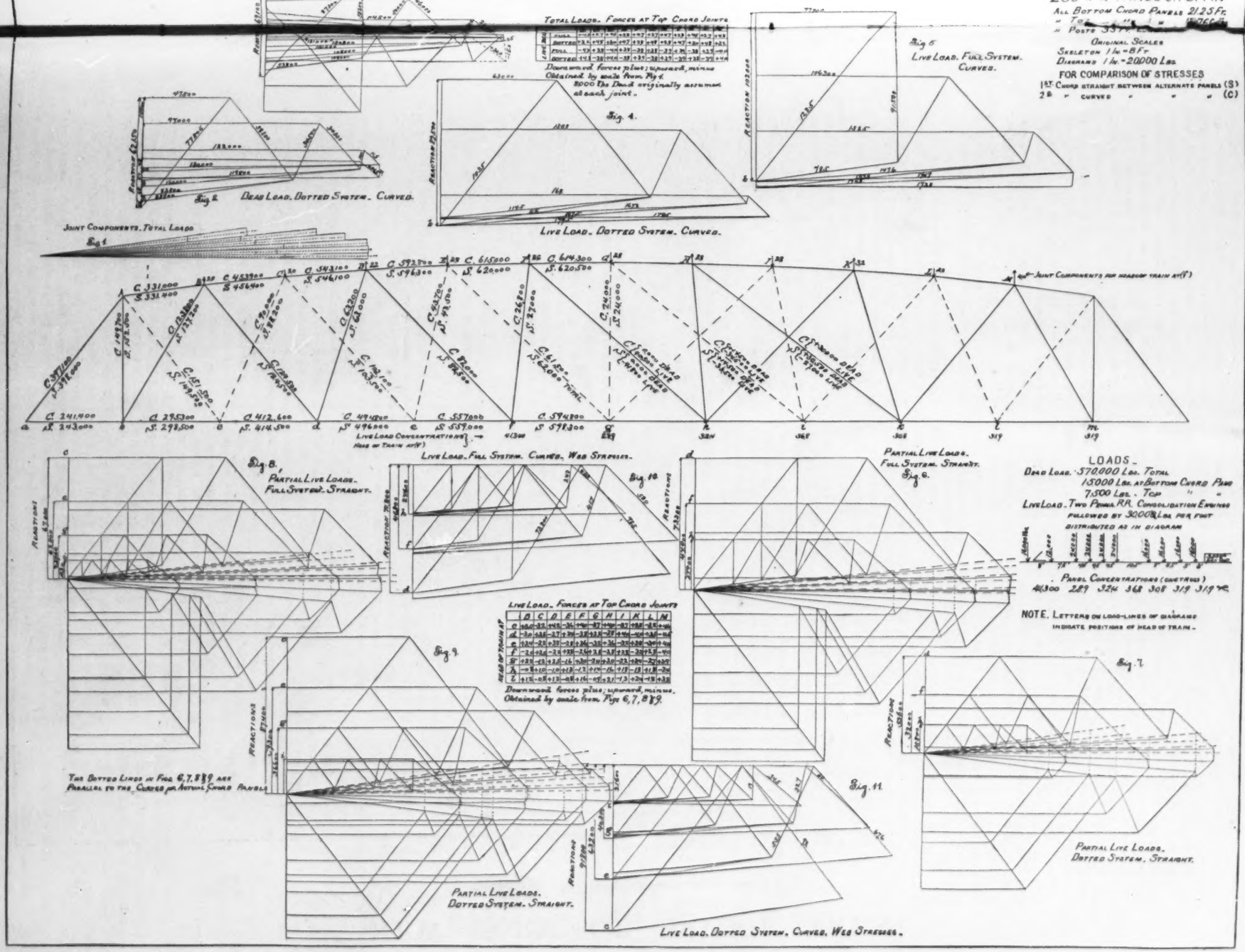
All Bottom Chord Panels 21.25 Ft.
" Top " " " "
" Posts 33 Ft.
Original Scales
Skeleton 1 in. = 8 Ft
Diagrams 1 in. = 20000 Lbs.
FOR COMPARISON OF STRESSES
1st Chord straight between alternate panels (S)
2d " curved " " " (C)
Total Loads. Forces at Top Chord Joints
Downward forces plus; upward, minus
Obtained by scale from Fig 4.
2000 lbs Dead originally assumed at each joint.
Fig 4.
Live Load. Dotted System. Curved.
Fig 5
Live Load. Full System. Curved.
Fig 2
Dead Load. Dotted System. Curved.
Joint Components. Total Loads
Fig 1
Live Load Concentrations (Head of Train at F)
Fig 8.
Partial Live Loads. Full System. Straight.
Live Load. Full System. Curved. Web Stresses.
Fig 10
Partial Live Loads. Full System. Straight.
Fig 6.
Live Load. Forces at Top Chord Joints
Head of Train at
Downward forces plus; upward, minus.
Obtained by scale from Figs 6, 7, 8 & 9.
Fig 9.
The Dotted Lines in Figs 6, 7, 8 & 9 are Parallel to the Curves on Actual Chord Panels
Partial Live Loads. Dotted System. Straight.
Fig 11.
Live Load. Dotted System. Curved. Web Stresses.
Fig 7.
Partial Live Loads. Dotted System. Straight.
LOADS.
Dead Load. 570000 Lbs. Total
15000 Lbs. at Bottom Chord Panel
7500 Lbs. Top " "
Live Load. Two Pennsylvania R.R. Consolidation Engines followed by 3000 Lbs. per foot distributed as in diagram
Panel Concentrations (Shattuck)
41300 289 324 368 308 319 319
NOTE. Letters on load-lines of diagrams indicate positions of head of train.

PLATE V.

This is an old story, and it is difficult to introduce any system into the smaller towns, where this thing most frequently occurs, that will change the existing relations of engineer and town authorities. Under the present system the selectmen will continue to be selected from the boilermakers and other live citizens of the place, and they will, in all probability, continue to assert the importance of their position by meddling in matters they do not understand. In this particular case the chief wrong done was in making the engineer practically responsible for a plan which was not his but the mongrel effort of a novice in engineering. But after the engineer has made this fact public and entered his protest, we do not know that he can do any more. The town will pay for the amateur "engineering" of its selectman, and if his theories are at fault it will also pay for his blunders. It is their affair.

Our whole system of doing public work, outside of the cities and larger towns which can and generally do have satisfactory engineering supervision, is all wrong. And we will continue to have shocking country roads, poor or unsafe bridges, and selectmen acting as engineers, until we follow English precedent in this thing and make laws which will put all such work under competent district engineers. But the change must be radical and sweeping, and as in England, the same laws that take these matters out of the hands of amateurs must see to it that they pass under control of competent engineers only. The law should fix the qualifications of the aspirants for position and these should pass before an examining board made up of experts and not selectmen. In other words, while the town authorities should alone decide whether certain work should or should not be done, the execution of this work should belong to engineers alone, untrammeled by the ignorance or personal motives of non-professional men, even though the latter be the best men in the town otherwise and sin from ignorance alone, as is very often the case. This is a broad subject at the present time; but the evil complained of by our correspondent cannot be remedied by individual action; a general and stringent law alone can effect any good.

Locomotive Coal Consumption and Temperature.

There is nothing which will lie like experiments, if the utmost care be not used to interpret them correctly. It is vastly easier to make them than to interpret them, as has been illustrated a thousand times. Our correspondent in last week's issue, under the above head, brings up a difficulty which is an admirable illustration of this fact in narrating some interesting tests of the rate of radiation from locomotives. He compares two incomparable things, the rate of radiation from locomotives under totally diverse circumstances, and finds that they do not agree. It is not surprising. But as both records are interesting in their way it may be interesting to compare them and see why they could not be alike.

The record which he refers to from the "Economic Theory of the Location of Railways" is not properly one of experiments but one of fact. It gives what the actual records of winter and summer monthly coal consumption, by comparison with the monthly temperature, show to be the effect of temperature, viz.: that "*the effect of difference of temperature alone, length of train and all other conditions being equal, is to increase or decrease coal consumption at the rate of* ONE *per cent. for each* TWO *degrees Fahrenheit* (and a small fraction more) *difference of external temperature*," a rule which is stated to be practically invariably and to apply fairly well to both passenger and freight service.

The evidence on which this rule was formulated has never been published; we fear for the most part it never will be published, since it takes almost as much work to prepare such evidence for publication as it does to collect it. In great part it consisted of diagrams of the aggregate locomotive coal consumption of various roads, with the average monthly temperature of points on the line plotted along side it for comparison. The coincidences are astonishing, and such as to permit of no doubt whatever that the law is substantially accurate. Summers or winters which are particularly hot or cold will always (where the coal records are accurate) show a larger or smaller coal consumption per mile run than in the preceding and following seasons when they may have been only a degree or two different. In cases where there is something particularly abnormal, as for instance, a slightly colder July than June or August (for July is nominally the hottest of the year, contrary to a general impression) the coal consumption of half a dozen roads will show a corresponding eccentricity. In parts also, the evidence consists of analysis of various coal tests on successive days, always made for some other purpose than to determine the effect of temperature, as for instance the many tests extending over months together, for comparing various qualities of coal or kinds of boilers or condition of tubes. It is a very common thing to find reports on these matters, in which it is assumed with childlike innocence that the temperature of July, August and September, or of 70°, 80° and 90° days, are practically all the same for coal consumption, and the whole question is neglected. On the contrary the coal consumption on a 70° day is *normally* 10 per cent. higher than on a 90° day, and when there happens to be a majority of 70° days in one series, and of 90° days in another it makes sad work of the resulting percentage, or would if the experimenter ever thought of this matter, which in coal tests they rarely or never do. It illustrates the very narrow range of view of some of our railroad officers that in the whole series of the Master Mechanics' reports for example, and in the many miscellaneous records of tests which have been described, there is not one in which the coal consumption of the same engine or engines on days of different temperature is analyzed and compared. Yet it is one of the most important and most promising fields of exhaustive investigation which could occupy the attention of mechanical experts.

But granting the law; it is one thing to determine such a law as this—which we risk nothing in saying may be regarded as absolutely determined,—and quite another to determine what it means. Does it mean necessarily that the *locomotive* radiates heat at this rate? By no means. It simply means that the heat which comes from the extra coal consumption is lost in some way. We regard it as more than probable that a very large fraction of this enormous loss occurs not in the locomotive, but at the journal boxes of the cars. The fact seems to be that journals in good order run at about the same temperature winter and summer, barely warm to the hand. As the temperature falls below this the lubrication seems to be less perfect and more friction is caused, generating more heat and bringing up the temperature. Now, the radiation from a journal-box is much more rapid of course in winter than in summer, because the difference in external and internal temperature is vastly greater, which it should not be in the locomotive. In the locomotive there is a normal difference of some 350° in external and internal temperature in zero weather against only 70 in a journal-box. A rise to 70° wipes out the latter difference wholly, but reduces the former by but a trifling percentage, the hottest summer day being almost as cold to the boiler as the coldest winter day. There is therefore room which does not exist in the locomotive for an enormous *percentage* of difference in radiated heat, from the journal-boxes in hot and cold weather, hence of friction, hence of power wasted, and hence of coal consumption. We do not assert that there is such a difference between winter and summer journal friction. We do not know. Neither does any one else, to the best of our information and belief; and what seems still stranger, there is no one who seems disposed to take the trouble to find out, although it is at least a most promising field for investigation, for journal-boxes expose their bare iron surfaces in winter to a fierce gale of frosty air. Heat is lost from 20 to 200 times as rapidly under such circumstances as in still air. There is at least a strong probability that mere sheet iron wind-guards, which would surround the boxes by still air would have a very marked effect on the radiation and hence on the train resistance and coal consumption. We deem it highly probable that 10 per cent. of the winter coal consumption might be saved in this way, but it is a very difficult subject to investigate experimentally. One thing is certain; it takes 772 ± foot-pounds of work to raise a pound of water 1° in temperature, and it is a rather costly way of heating—whether it be journal-boxes or houses. For a journal-box which is running hot it is an advantage, but the vast majority of them do not run hot, or freight rates would not be what they are.

But after excluding this source of error, and coming to the locomotive only, there is a vast deal of difference between the radiation from a locomotive hauled as a dead engine behind a train of cars, and a locomotive working under full steam at the head of a train. Our correspondent made the following interesting test:

A locomotive with fire drawn, smoke-stack closed and valve rods taken down, and with steam at 113 lbs. lost heat after being pulled 60 miles at 39 miles per hour at the rate of

$$\text{Loss in H. U.} = 0.052\ D.\ T.^{2.1}.$$

D being the distance in miles, and T the average difference in external and internal temperature. At this rate, if we assume a constant steam pressure of 120 lbs., and external air 70°, the loss per mile in heat units would be:

$$L = 0.0252\ (350-70)^{2.1} = 3471 \text{ H. U.}$$

This is a very trifling loss indeed. If we take the heating power of coal at 13,884 H. U. per lb., which is that of good average coal, it requires only the consumption of ¼ lb. of coal per mile, theoretically, to make it good, and practically only about twice that amount at most, the efficiency of the boiler being over 50 per cent. We are unable to find our correspondent's formula in his data, however, which appear to be thus:

	Total H.U. per °Fah.
Weight of boiler, 21,000 lbs. specific heat ⅛	2,333
Weight of water, 10,000 lbs. " " 1	10,000
Total H. U. for rise or fall of °Fah	12,333

The actual fall of temperature, as measured by the fall in steam pressure was.

	Press. fall.	Temp. fall.
First 25.3 miles.	113 to 92 lbs.	346° to 332.6° = 13.4°
Second 23 "	87 to 73 lbs.	329.1° to 316.6° = 12.5°
Total for 48.3 miles		25.9°

This is approximately ½° per mile or 6,167 H. U. per mile in place of 3,471, but at most this accounts for a waste of coal by radiation *of this kind and under these conditions* of only

1 lb. per mile, or 39 lbs. per hour at the given speed.

Now this does not check very well with direct tests by Mr. REUBEN WELLS as to the actual amount of coal which it took to keep up steam at 80 lbs. constantly in an engine standing still in the yard and carefully protected from radiation. He found it to amount to from 25 to 32 lbs.; yet the radiation under these conditions should certainly not be over one-tenth as much as in motion at 20 miles per hour. A possible (in fact the probable) explanation is that with such slow combustion in a locomotive fire-box the interior temperature is too low for economy, and an enormous proportion of the heat goes out with the air through the chimney.

Our correspondent gives another formula for the loss when standing still, based on only 9 minutes' observation, which gives a radiation of $25 \times 60 \times 280 = 420{,}000$ H. U. per hour lost under these conditions, against only $3471 \times 39 = 135369$ H. U. per hour, which his formula gives as the loss in motion at 39 miles per hour, and $6167 \times 39 = 240{,}513$ H. U., under the formula which we have computed for motion at 39 miles per hour. This is plainly impossible. The still radiation must be much the smaller. Allowing half of the 14,000 H. U. in good coal to be actually put into the water, his formula for still radiation would give $420{,}000 \div 7{,}000 = 60$ lbs. of coal per hour to supply this loss, or more than double what Mr. WELLS found necessary in actual experiment under very favorable conditions for economy.

Now what is the reason for this apparent conflict between theory and practice? It is a lesson to experimenters. Brief as was Mr. KLEIN's test it was under conditions making it apparently safe to draw conclusions from. He had a known amount of heat stored in his boiler, which could be computed exactly. The steam pressure, if correctly observed, is a most accurate thermometer. If his pressure falls, as it did fall, 5 lbs. in standing still 9 or 10 minutes, it is a mere arithmetical and tabular process to compute from it the loss of temperature in degrees, and these, knowing how many heat-units it takes to raise the temperature of his whole boiler 1° F., to compute the loss of heat-units, and how much coal it represents. The same is true of his loss in motion, and he has the resulting conclusion as plain as day that the loss by radiation amounts to only a pound or so per mile, whether the engine be in motion or standing still for an equal time in the yard.

Yet this conclusion is utterly and extravagantly erroneous. *The fact* is that even a rather light engine burning 50 lbs. of coal per mile will burn 1 lb. more for a *difference* of 20° to 25° in external temperature. If there be so much loss from a *difference* of only 20° what does it appear to indicate is the absolute loss in each case? We cannot even surmise, because of the journal-box doubts before mentioned, but aside from that there is a tremendous possible source of loss in actual service which does not exist at all in a dead engine, viz. internal radiation of heat from the hot walls of the cylinder into the exhaust. It would lead us too far to explain the nature of this loss in detail to those who do not already understand it, but it is beyond doubt a serious waster of heat, and possibly much more important than the external radiation. But even as to the latter alone, a test with a dead engine using no steam does not give a fair indication at all of what it is in service, for two reasons: there is no radiation going on from the cylinders and connected parts, and—still more important—there is no circulation going on within the boiler, to keep the temperature of the interior boiler surfaces up to that called for by the nominal pressure. Water and steam both being among the poorest of conductors, and circulation being much impeded by the tubes when no steam is making, it is not probable that the actual temperature of the interior skin of the boiler is any where near that of the interior of the water, and of course the radiation will fall correspondingly.

Add to this that the engine experimented on was hauled behind, instead of pushed ahead of a train, as it should have been, and we are led to the plain conclusion that our correspondent's tests, however interesting in themselves, shed only the faintest and most dubious light on the problem we suppose him to have been investigating, the total loss of coal by radiation, as an effect of differences of external temperature.

There were some experiments made many years ago by J. C. HOADLY (*Journal of the Franklin Institute*, April, 1878, on a small portable boiler which it would be interesting to compare with our correspondent's results, but we lack the time and space. We shall be pleased to have any one do so and send us the results. They showed a radiation in still air from naked and clothed boilers in the proportion of 5 to 12, and our impression is showed a much larger absolute loss of heat per hour.

The Car Coupler Committee's Report.

We are authoritatively advised that the Coupler Committee, whose report appears elsewhere, while directing attention in their report to certain structural weaknesses of the vertical hook couplers, heretofore presented for its consideration, still endorses the vertical hook of the Master Car Builders' type, with such modifications as are promised by the different manufacturers, as the only practical coupler for freight service. The tenor of their report affords some little ground for being doubtful of this, and we are therefore much pleased to hear it. It would certainly be most unfortunate for the public if it were otherwise, and we think for the Committee as well, for it would be as improper as it is unnecessary to reopen in any way the settled question of the form and type of the standard coupler, and would be sure to provoke much adverse comment.

But from the general tone of the Committee's report, which the Committee themselves admit by the fact that they find it necessary to contradict what they deem a probable impression, it seems clear to us that they do not sufficiently realize that since the recent decisive action by the Master Car Builders' Association in adopting a standard *type* of coupler, the very great importance which has heretofore attached to the selection of any particular make of coupler has passed away, both for the public and for the companies concerned. For let us suppose that by mistake of judgment a particular make of coupler, *conforming to the standard*, has been adopted, which does not prove equal to some other make. It is still serviceable and can be used until worn out, just as are purchases of inferior supplies of any kind. Unfortunate little accidents of that kind are common to the purchase of every form of supplies, but such a possibility affords no more warrant in the case of couplers than in the case of rails or wheels, for standing still and doing nothing until something ideally perfect—if not unattainably perfect—has been evolved; as there certainly was warrant in the inchoate state of the coupler question a year ago.

It is all a question of degree. A moderate delay on the part of the Committee in picking out the best from several passable couplers, is not only pardonable but commendable, and may be a duty which they owe to the companies they represent, since we understand that they have all agreed to accept the decision of a bare majority, and it must not be forgotten that the Committee are acting for a very large mileage which has agreed to adopt whatever coupler they may recommend. But here comes in the grave mistake which the Committee are making, in their apparent attitude at least. They do not appear to recognize the late change in the situation. It no longer matters a particle whether the companies represented agree on identical couplers or not, provided they do not deviate from the already established M. C. B. standard. One may adopt the Janney, another the Hein, another the Dowling or Thurmond, and so on, and the only possible loss which can come to them will be from the *difference* in durability of the makes adopted and rejected. They will all inter-couple; they can all be used until worn out, and whenever one is found to be inferior, it can be dropped at once, and a different make substituted for further work, without any more loss than comes from the temporary use of a poor brand of boiler iron or of rails. And there is this further argument in favor of such non-unanimity, that the protracted and extensive tests of actual service are of vastly greater worth than any amount of laboratory tests, which may easily lead to delusive conclusions, as they so often have led.

In fact, we strongly suspect that the Committee are setting themselves an impossible task, which they cannot discharge with justice to the others, in attempting the needless task of specifying some one or two couplers only. As respects three or four makes of coupler at least, we do not believe that there are such advantages of mechanical design with either but that any one of them, thoroughly well made, will endure more than another make a shade off in quality. Supposing then, the Committee find that this or that coupler *of those tested* will endure more than the others. It is no sign that it may not hereafter be so poorly made, or the others so well made, as to prove decidedly inferior in service.

At the time this Committee was organized the Master Car Builders had done nothing and gave no promise of doing anything, and we think there can be no doubt that its creation stirred up that rather inert body to its late decisive action, and so was a very fortunate fact. But that action having been had, and being now generally accepted, further action which looks in any way towards the erection of a different or more restricted standard than the very broad and satisfactory one which is already established will, we are satisfied, have an injurious effect. More unanimity than it contemplates is of no importance. To the extent that we rejoice in seeing suitable tests made of rails or wheels before they are bought (or should rejoice if such tests ever were made) we rejoice in seeing the work that the coupler committee are doing. It is all good and needed work, carried only to a proper extent. But as it would hardly be proper to suspend needed repairs until a board of experts should determine (if they could) what was absolutely the best rail or wheel made, so we cannot but regret that the Committee should put itself in an attitude where it is even obliged to disclaim that it is not seeking to reopen the whole question, although we have no doubt that it is acting from the most conscientious motives.

NEWS comes from China of an almost unprecedented overflow of the Hoang Ho river or "China's Sorrow" as it has long been called. The present meagre accounts say that this terrible river has left its old bed and now forms a lake 30 ft. deep over the site of Chingchow and ten other populous cities. The missionaries state that the loss of life is incalculable and millions of Chinese are homeless and starving.

The Ultimate Cost of the South Pass Jetties.

In the last official report of Secretary of War ENDICOTT is a detailed statement showing the payments made and to be made under the contract with the late Mr. JAMES B. EADS for the construction and maintenance of the Mississippi jetties at the South Pass. We make an abstract of this for the benefit of our general readers.

Under the Act of March 3, 1875, the United States agreed to pay JAMES B. EADS, or his legal representatives, $5,250,000 for creating and permanently maintaining a 350 ft. wide channel, 30 ft. deep, between the South Pass of the Mississippi river and the Gulf of Mexico; and the Government also agreed to pay $100,000 for each and every year that the depth of 30 ft. should be maintained in the South Pass during 20 years after securing this depth. The conditions of payment of the $5,250,000 were as follows:

For a channel 20 ft. deep and not less than 200 ft. wide, $500,000; and $500,000 more on each increase of 2 ft. in depth and a corresponding width of channel up to 350 ft. After 24 ft. × 250 was maintained for 12 consecutive months, $250,000 additional was to be paid; and the same for channels 26 × 300 ft., and 28 × 350 ft. After a channel 30 × 350 ft. had been maintained 12 consecutive months an additional $500,000 was to be paid. This last payment made a total of $4,250,000, but the other $1,000,000 now earned was to remain in the possession of the United States as security, but on interest at 5 per cent. payable to Mr. EADS and his representatives semi-annually, from the date when the 30 × 350 ft. channel was secured and as long as the Government retains possession of the principal. When a channel 30 × 350 ft. had been maintained 10 years, $500,000, or one-half of this reserve, was to be paid to Mr. EADS; and when maintained for 10 additional years, or 20 years in all, the remaining half was to be paid.

Under this Act Mr. EADS was paid to March 3, 1875, $1,000,000. At this date the Act was amended to provide as follows:—That on his relinquishing the claim for $500,000 on securing a channel 24 × 250 ft. the sum of $500,000 be paid Mr. EADS; and that monthly payments, not exceeding in the aggregate $500,000, be made to Mr. EADS for material and labor as certified to by the U. S. Engineer officer, provided that Mr. EADS relinquished all claim to the $250,000 due for maintaining a 24 × 250 ft. channel 12 consecutive months, and provided further that said Mr. EADS shall from time to time, as monthly installments of the remaining $250,000 are paid, relinquish like amounts to be deducted from the $500,000 due for a channel 26 × 300 ft.

On June 21, 1878, Mr. EADS was paid $500,000 for a channel 24 × 250 ft.; and between June 19, 1878, and March 2, 1879, he was paid in total $716,882.06, including the $500,000 first referred to. On March 3, 1879, the Act was again amended as follows: Payments in lieu of these provided by the Act of March 3, 1875. JAMES B. EADS to be paid $750,000; when a channel 25 × 200 ft. is obtained through the jetties, $500,000; a channel 26 × 200 ft., $500,000; a channel of 30 ft. in depth without regard to width, $500,000; and the $1,000,000 reserved by the Act of 1875 to be paid in the manner provided in that Act. The $100,000 per annum to be paid for 20 years as before provided, but upon the maintenance of a channel 26 ft. deep and not less than 200 ft. wide on the bottom, and having through it a central depth of 30 ft. without regard to width.

Under the Act of 1875 as amended in 1878 and 1879, Mr. EADS has been paid $2,558,117.94; including the payment of interest on the $1,000,000 reserve and the total payments to March 2, 1879 ($716,882·00) the sum total of payments to Mr. EADS to Oct. 6, 1887, was $5,450,000. The grand total of the EADS contract, under the original and amended Acts, will amount to $8,000,000; hence there remains to be paid, under certain conditions, subsequent to Sept. 29, 1887, the sum of $2,550,000.

IN the *Philadelphia Gazetteer*, of May, 1796, the Editor, Col. ELEAZER OSWALD, complains because "yesterday (Monday) completed one hundred and five days since accounts from England have reached any part of the United States." Comment on the difference between the diffusion of news then and now is unnecessary.

Automatic Coupler Tests.

The committee organized to secure the adoption of a uniform draw bar and coupler for freight service, of which Mr. W. P. SHINN is Chairman, issued last week the following report, which, as we then stated, we were compelled to postpone publishing until this issue. After summarizing their earlier action, which we have already reported, on 4 link and pin and 7 vertical hook couplers, they say:

At the same meeting as that at which it was resolved to test further couplers of the Janney type, the following was adopted by the committee:

Resolved, That the secretary be instructed to call upon the owners of the couplers, which are to be further investigated by the committee, and request each to furnish the committee with 5 cars of 40,000 lbs. capacity, or over, equipped with his coupler, and delivered at such point as may be arranged for, where service trials may be made in trains, and that the owners of such couplers, as do not already couple with the Janney, be requested to make such modifications, as will enable them to do so, and use only such modified couplers on the cars sent to the committee.

By the courtesy of the general manager of the West Shore railroad, arrangements were made for the service test to take place in the yard of that company near Weehawken.

The first service test was made Oct. 14, with 5 Pennsylvania Railroad cars, equipped with the Janney freight coupler, and 5 Pittsburg, Cincinnati & St. Louis cars, equipped with the Dowling automatic coupler. The cars having each type of coupler coupled readily with each other, and the Dowling and Janney coupled with each other, and uncoupled without difficulty, on the straight and curved tracks, including reversed curves on switches, such as were found in the West Shore yard. The hook of one coupler, which was coupled to an ordinary draw bar with a link, was broken, and it exhibited a fracture, which indicated that the material was not properly applicable to that purpose. The trial of coupling the Dowling and Janney couplers on a curve of 31⅔°, in the Weehawken dock, yard, demonstrated, that while each coupler would couple with that of its own class, it would not couple readily with the other on that curve. This test was an extreme one.

On Oct. 15 the committee held a meeting, and received a verbal report from Capt. MICHAELIS of the physical tests made by him, upon which the following was adopted:

Resolved, That Capt. MICHAELIS be authorized to communicate with either of the contestants, the results of his tests, as far as they develop weakness or defects in their own couplers, but such information not to be imparted to the owner of any other coupler than the one reported upon.

The chairman having received a communication from parties in interest, asking for an extension of time and an opportunity to submit other couplers for the service test, the time was extended to Nov. 5, and subsequently to Dec. 15, in order to permit the Barnes and Thurmond couplers to be represented, as well as those heretofore tested.

The physical tests which Capt. MICHAELIS was authorized to make were made at the Troy Iron & Steel Co.'s works, in Troy, N. Y., Oct. 6 and subsequent days. A portion only of the tests proposed were made, and on Nov. 12 Capt. MICHAELIS made a report, of which the following is a synopsis:

REPORT OF THE EXPERT ON PHISICAL TESTS.

The test was made with a drop, 1,640 lbs. weight, falling as follows: One blow, 6 ft. fall; three blows, 9 ft. fall; three blows, 12 ft. fall.

In the first series of tests each coupler was freely supported on its draw-bar springs. In the second series the springs were taken out and each coupler rested on an iron block with elastic backing. The 6 ft. blow is equivalent to that given by a 30-ton car moving very nearly at the rate of 2 miles an hour; the 9 ft. blow at 3¾ miles per hour, and the 12 ft. blow at nearly 4¾ miles per hour. There were four couplers tried with the following result, the couplers being designated by number:

First Series of Tests. (Resting on Springs.)

Coupler No. 1, under 6 ft. blow, showed slight bending of the axle pin and knuckle compression; this increased with each blow. On the third 9 ft. blow the pin showed shear-strain, and after that blow the knuckle was immovable. The first 12 ft. blow locked the knuckle; the second developed a crack at rear of knuckle arm; the third destroyed the coupler. Pin had sagged 0.4 in.

Coupler No. 2, stood the blows fairly well. The knuckle showed continuous compression, and after the seventh blow, the axle pin was found slightly bent. At this blow the drawhead shank pin bent and cracked through the key hole.

Coupler No. 3 showed throughout the test slight but progressive bending of the pin, and increasing knuckle compression. At the sixth blow a crack was developed through the knuckle arm, and the knuckle shank no longer cleared the draw-bar opening. At the seventh blow, the knuckle arm was broken completely off in two pieces. The pin showed a sag of 0.08 in.

Coupler No. 4 showed progressive compression under each blow. At the third blow the knuckle broke, and the hook rotated off its shank. The fracture showed that the metal was not adapted to the purpose.

Second Series of Tests. Without Springs.

Coupler No. 1 went to pieces on the second blow; the pin showed a sag of 0.24 in.

Coupler No. 2 showed slight but progressive bending of the axle pin with each blow, as well as knuckle compression. The knuckle showed progressive distortion. After the seventh blow the knuckle shank was thrown 1 in. out of its normal position, the head cracked at the seat of the knuckle shank end.

Coupler No. 3 showed slight but progressive bending of the pin at each blow. At the fifth blow, the guard arm cracked at the junction of the flat portion of the head on the upper side. The pin had sagged 0.08 in.

Coupler No. 4. The knuckle broke at the first blow, being replaced with another knuckle of different and more malleable metal, the first blow showed a knuckle compression of 1/16 in. The second blow, 9 ft. showed additional compression of 1/16, and at the third blow, 9 ft. the head went to pieces, the knuckle being unharmed.

For years to come the freight car coupler must be used, not only as a coupler, but to a certain extent as a buffer. This makes it necessary to have couplers of a metal and construction that will admit of severe impact shocks, without distortion or breakage. That means, that it must be made of material sufficiently strong, and housed with absolute security. Practical construction limits the size and weight. Within these limits it is clear, that a knuckle strong enough in itself, must not depend for support on an axle pin. The shocks are cumulative in their effects, and there must come a time, as exemplified in the coupler designated as coupler No. 1, that the sag of the pin first interferes with the operation of the hook, and then leads to the destruction of the head, because the strain is brought upon a part not intended to bear it, or as in that designated as No. 3, of far greater strength, where the slighter sag of the pin does not interfere with the working of the knuckle, but where it also leads to the breaking of the head, as described. Hence the committee, will be perfectly justified in deciding that no coupler can meet the requirements of the freight service, which from the very nature of its construction permits strain upon a supporting pin. There is also another requirement: Upon receiving the blow, the knuckle must virtually be one with the head, and be so seated as to call out its full resistance precisely as does the link and pin coupler. In none of the couplers presented to the committee, has this essential requisite been made. The representatives of but one of the couplers have taken advantage of the privilege, accorded to competitors, to acquaint themseives with the results of the tests, and are understood to be endeavoring to profit by them. The tests already made fully support the wisdom and necessity of the committee's establishing these two requirements as pre-requisites to further trials, and as vertical hook couplers can comply with them, no hardship is imposed.

(Signed) O. E. MICHAELIS, Ph. D.

The committee submits the foregoing report of progress to account for its delay in coming to a decision, with the opinion, *as expressed in the report of our physical test expert*, that none of the couplers presented fulfill the conditions requisite to adoption by this committee as a coupler which it can recommend to its constituents. While modifications are pending in the form of the head and hook, and in some details of the coupler, the committee have considered it unwise to urge the competitors to prepare for further tests until they could make such modifications as seem to them necessary to meet the requirements of the committee. The committee has, throughout, been actuated first by a desire to adopt only such couplings as would unquestionably meet with the approval of the companies represented by the committee, and second, to put the contestants to as little expense as could reasonably be done, consistent with attaining the object of the committee.

All of which is respectfully submitted.

(Signed) WM. P. SHINN, Chairman.

CORRESPONDENCE.

A Book on Masonry.

DANVILLE, Ky., Dec. 10, 1887

EDITOR ENGINEERING NEWS:

Will you kindly inform me what is a good work on masonry and stone cutting, giving just such information as a resident engineer or division engineer would need; especially an "engineer" who is lately out of college and not very rich in experience. I look in vain over your little leaflet headed "A Civil Engineers' Library," but am satisfied you know about the book I want. I do not mean anything elaborate like fine masonry on the costly bridges; just plain, elementary practice. What is the cost of the printed volumes of "Transactions of Am. Soc. C. E.," and the value of them to a young "beginner?" B.

[There is no such book on masonry, although there is a "yawning void" for it to fill. "Plain elementary practice" is about the last thing which the average engineering treatise is troubled with, for two reasons; 1, the authors are not very well posted about it, themselves, and, 2, it takes more work to present it worthily than to give two or three plans of very large structures and dismiss all the rest—the bulk of engineering practice—with a few safe generalities. We presume our correspondent has TRAUTWINE; it is not open to these objections, so far as it goes, but does not pretend to cover the field our correspondent wishes. There is a very thin little book published by the *Rail-*

way Age of Chicago, at $1, which certainly contains a dollar's worth of information for a beginner, and is practical, so far as it goes, which is a very little way. The only other existing source of information we now recall is—experience. The printed volumes of the Transactions of the American Society of Civil Engineers cannot be had at any price except through a member at a rather dear rate. If our correspondent is under 26 years of age he will be able to secure them after March, 1888, by obtaining admission to the Society as a Student, at $6 per annum, if the proposition to establish that grade is carried, as it no doubt will be. Their value to a "young beginner" depends on who he is. To some they are very valuable; to others, not so.—ED. ENG. NEWS].

Credit to whom Credit is Due.

PHILADELPHIA, Pa., Nov. 30 1887.

EDITOR ENGINEERING NEWS:

I notice on page 380 of your journal, dated Nov. 26, 1887, an article entitled, "A New Type of Pumping Engine," and the claim that the engines described are the first of that type built in this country.

Allow me to refer you to your issue of August the 29, 1885, where you will find a full page illustration, and a detailed description of a pair of vertical duplex pumps of *similar type*, which were erected at Red Bank, Monmouth County, N. J. The pumps were built by WORTHINGTON; and the intermediate trestle between the steam and water cylinders, the piston rods, beams, etc., were furnished and erected by the Wharton Railroad Switch Co., of Philadelphia.

Each pair of pumps had a capacity of 600,000 galls. in 24 hrs., and delivered the water to an elevation of 169 ft. to the reservoir.

The well was 15 ft. in diameter, and some 70 ft. in depth. The pumps were *suspended* in the well by a trestle work 41 ft. 8 ins. in length; and the water pumped from a depth of 54 ft. below the surface of the ground.

The piston rods were made of 2¼ *in. wrought-iron lap-welded pipe*, with brass sheathings, and were guided in adjustable bearing boxes at intervals in the length of the trestle.

The high-pressure steam cylinders were 10 in. in diameter; the low-pressure steam cylinders were 16 ins. in diameter; the water plungers were 10¼ ins. in diameter; the length of stroke was 10 ins.

These pumps went into service in the early spring of 1885, and have been in continuous operation ever since. The writer, by whom they were designed, has as yet to hear of any complaint from the Water Commissioners at Red Bank, N. J. From this, you see, that this style of pumping engine is not only not new, but that it has been both noted and illustrated in your journal.

Hoping that you will publish this letter, crediting the novelty (if it may be so called) to the proper parties, I am, Yours very respectfully,

CHAS. G. DARRACH.

[We acknowledge our remissness in consulting our own files in the above matter. And on comparison find very little difference, as our correspondence says, between the two schemes as carried out. Red Bank is certainly ahead in priority of claim for novelty of design.—ED. ENG. NEWS.]

Strange Behavior of Cement.

BUFFALO, N. Y., Dec. 2, 1887.

EDITOR ENGINEERING NEWS:

In your issue of Nov. 26, 1887, I find an article headed "Strange Behavior of Cement." As I am somewhat acquainted with the Buffalo cement, and have seen it used a great deal, and also having known of the failure of it in the work at the mouth of the Muskingum river, I take the liberty to write you. I have never known of a failure of the Buffalo cement except this one, but have known of a great many failures of the Buffalo *Portland* cement, and as near as I can find out, the cement used at the mouth of the Muskingum was a mixture of the Buffalo cement and the Buffalo *Portland* cement, which, to my mind, caused the failure.

I will cite you one instance of the failure of the Buffalo *Portland* cement: During the fall of the year 1878 and the year 1879, there was about 2,000 barrels of the Buffalo *Portland* cement used in the construction of the cellar floors of the "State Asylum for the Insane, at Buffalo, N. Y." In about two years after the floors were laid the cement began to swell, the floors checked, and the cement softened and disintegrated so that the floors had to be taken up in the year 1884, and were relaid with imported *Portland* cement, thereby costing the State a large amount of money.

The above is only one instance, there are many others, only on a smaller scale. A few years ago the Soldiers and Sailors Monument was erected here in La Fayette Park. The foundation was laid with Buffalo *Portland* cement. When I saw it being used I told some of my friends that the city of Buffalo would have trouble with the monument in a few years, and told them the reason. I was laughed at by some of them. The trouble has commenced. The huge stones at the base of the monument are being forced out of place, and they will have to be replaced in the spring at a great expense. (So says the committee appointed to investigate the cause.) My opinion is that the entire monument should be taken down, the entire foundation removed and replaced with foundation in which some other cement is used, as I think the swelling of the cement now in the foundation will continue some time longer. As you may not know how the Buffalo *Portland* cement is manufactured I will give a brief description of it

Their rock is quarried and burned in a kiln with coal, in the usual way with the manufacture of natural cement in this country, only they use a little larger amount of coal, so as to burn the cement very hard, considerable of it being vitrified, or burned to a clinker. The hard-burned, or vitrified part, is separated from the other, and finely ground, and is called Buffalo *Portland* cement. The softer burned, or calcined part, is the Buffalo cement. The Buffalo *Portland* cement will stand a good test, for a test of from ten days to one year, but in a great many instances, after it is from one to three years old, it will disintegrate. I cannot explain the reason why it will do so, but nevertheless such is the fact. Q.

Progress Map No. 4.

BALTIMORE, MD., Dec. 6, 1887.

EDITOR ENGINEERING NEWS:

Those maps of yours are great things, immense so to speak, and they do me much good, but, (there is always a but) your compiler is so busy with new roads that he has overlooked a road or two which have been built since kingdom come. For instance, the old Seaboard & Roanoke which has been carrying trains between Weldon, N. C. and Portsmouth, Va., for 30 years, has escaped your compiler's notice. And in the same district, he has omitted the branch from Halifax to Scotland, and the branch from Henderson to Oxford. It so happens that I have made a few hard earned dollars out of each of these three omitted roads, and would really like to know where to find them again in case any more opportunities should become apparent to the naked eye. Please resuscitate them for my benefit and greatly oblige, Yours truly,

FRED H. SMITH.

[As stated in our prospectus, it is our intention to have upon our map in black *all* the railroad lines doing business as common carriers of both freight and passenger traffic on Jan. 1 of the current year. But of all the flood of maps with which enterprising publishers inundate the country, there are very few which are not full of errors and omissions. Our own maps were compiled from several of the best authorities obtainable and corrected by information directly from the railway officers themselves, in all cases where we were able to obtain it. With all our pains, however, when the extensions of the present year were located upon the map omissions were found and noted in various parts of the map, and for some reason were especially numerous in eastern North Carolina, as our correspondent has stated. All these of course we shall correct in future editions, and we thank Mr. SMITH for calling our attention to them. We especially request that errors and omissions of every sort upon our maps or the accompanying lists or in our weekly news of new construction be called to our attention by our correspondents and subscribers who may notice them. They will in this manner materially assist in making ENGINEERING NEWS as accurate and reliable as we earnestly desire it to be.—ED. ENG. NEWS.]

Unsymmetrical Sections.

Sheffield Scientific School of Yale College.
Dec. 10, 1887.

EDITOR ENGINEERING NEWS:

I would like to make a few remarks upon the point raised by Mr. THOS. H. JOHNSON, in your issue of December 3d.

The conditions of equilibrium in the cases cited are three: 1st. There must be no motion up or down; 2d. there must be no motion right or left; 3d. there must be no rotation. All three of these conditions must be fulfilled, or there is no equilibrium. It is not sufficient to satisfy one or two only.

Thus in the case of the lever, with a weight P at one end distant a from fulcrum, and a weight Q at the other end, distant b from fulcrum, fulcrum between the weights, we have, letting R equal the pressure on fulcrum,

(1.) $R = P + Q$, no motion up or down.
(2.) $O = o$, no forces acting towards right or left.
(3.) $Pa = Qb$, no rotation.

Now in the case of flexure the conditions of equilibrium at any section give us

$$(1) \qquad \sum \left\{ \begin{array}{l} \text{of the outer forces} \\ \text{on one side of section} \end{array} \right. = \text{shear.}$$

If this is fulfilled there is no motion up or down.

Let v be the distance from axis to any fibre, and let us assume that the elongation of any fibre is directly proportional to the distance from the axis, that is, *that any plane section before flexure, remains plane after*, then it is proved in all the text-books, that the elongation or compression of any fibre at any distance v, is $v \frac{d^2 y}{dx^2}$. Now if this be the elongation or compression, the corresponding force is $E \frac{d^2 y}{dx^2} v\, da$, where E is the coefficient of elasticity and da is the section of the fibre. Our second condition then is necessarily that the sum of all the fibre forces above the axis must equal the sum of all below, otherwise there would be motion right or left. If x be the distance from the axis to the top of section and z the distance from the axis to the bottom of section, we must have

$$(2) \qquad E \frac{d^2 y}{dx^2} \sum_{v=o}^{v=x} v\, da = E \frac{d^2 y}{dx^2} \sum_{v=o}^{v=z} v\, da$$

This condition then gives us *necessarily*, the axi through the center of gravity, whatever be the form of section, *provided it remains plane after flexure.* There is absolutely no escape from this conclusion *if you accept this premise of plane sections after flexure.*

Now the third condition, is that there shall be no rotation.

The moment of each fibre force is $E \frac{d^2 y}{dx^2} v^2\, da$, and we have then

$$(3) \qquad E \frac{d^2 y}{dx^2} \sum_{v=-z}^{v=+x} v^2 da = \sum \text{moments of all outer forces on one side.}$$

The summation on the left gives us the moment of inertia I. This is the argument of all the text-books, and as we see, it is thoroughly sound, if you admit the premise, of *plane section after flexure.* For a rectangular beam, of breadth b, depth d, and length l, fixed horizontally at one end, with a weight P at the other, we find for the deflection at the end. $\frac{4 P l^3}{E b d^3}$. This result is confirmed by experiments well within limits of elasticity, and hence confirms the premise.

Now if I understand Mr. JOHNSON, he claims that experiment in some cases shows that the axis does *not* pass through the center of gravity. If this is a fact, it shows in those cases that the premise is

wrong. But the premise cannot properly be corrected by inserting a condition which violates the conditions of equilibrium. Any correction, properly made, must satisfy our three conditions. Now Mr. JOHNSON claims that the *"neutral axis is that line which* equals the moments of inertia. If this be true, then his condition can only be introduced properly, by denying that the section *remains plane after flexure.* Not only this, but we must also assume that the elongation varies, not directly as the distance, but *directly as the square of the distance from the axis.* If *this* assumption be made, and only because this is made, can we have from our second condition of equilibrium.

$$(2) \qquad \sum_{v=o}^{v=x} v^2\,da = \sum_{v=o}^{v=z} v^2 da$$

This will indeed give us Mr. JOHNSON'S condition as a necessary condition of equilibrium, and this is the only way we can get it, without violating equilibrium. If Mr. JOHNSON wishes to put it on *this* ground, he is free to do so if facts and experiments warrant his premise. But he cannot hold the old premise of plane sections and *hold this too.* That is not allowable. It contradicts equilibrium.

Now if he assumes this condition, and also the assumption on which it rests, he must introduce his third condition in accord. If then $E \frac{d^2 y}{dx^2} v^2\ da$ is the fibre force, which according to Mr. JOHNSON, it must be, we must have for our third condition.

$$(3)\ E \frac{d^2 y}{dx^2} \sum_{v=-z}^{v=+x} v^2\,da = \sum \text{moments of all outer forces on one side.}$$

The summation on the left is no longer I, but it is the *moment of the moment of inertia.* Mr. JOHNSON cannot keep this still I, and insert his own condition too. In the case of our rectangular beam, we should now have for the deflection, $\frac{32\,P\,l^3}{3\,E\,b\,h^4}$.

This is the only outcome of properly introducing Mr. JOHNSON'S assumption. Is it in accord with experiment? If not, his assumption is at fault.

I do not claim that the neutral axis does always pass through the center of gravity. It may be quite true as Mr. JOHNSON urges, that it sometimes does not. But it is quite clear that Mr. JOHNSON'S condition cannot be introduced except as a condition of equilibrium. As such it involves an assumption as to the distribution of force over the cross-section, which yields a result not so well checked by experiment as the received theory. If we knew what this force distribution really was in the cases he cites, we could introduce possibly a better assumption than that of plane sections *after flexure.* But until we have such knowledge we cannot. Meanwhile we cannot accept in place of an assumption which leads to results which experiment checks in every case very closely, within limits of elasticity, an assumption which leads to results which do not so check. The conclusion is, that although the neutral axis may not always pass through the center of gravity, the assumption that it does need not be corrected unless it can be shown to lead to serious error, and if this is shown we need a better assumption than Mr. JOHNSON'S to help us out.

I need scarcely add that the foot note to which Mr. JOHNSON refers, has been long ago expunged, thanks to the kindly suggestion of Prof. J. B. JOHNSON himself, and that I fully agree with the latter, that Mr. JOHNSON cannot introduce his condition as he seems to seek to introduce it, without destroying equilibrium.

A. J. DU BOIS.

PERSONAL.

FREDERICK BERGWALL, a Civil Engineer, was instantly killed, on Nov. 30, at the pivot pier of the railroad bridge, at Portland, Ore., by the falling of a box of cement. Mr. BERGWALL was a native of Sweden and was 27 years old.

RUDOLPH HERING has been engaged as Consulting Engineer by the city of Montgomery, Ala., to examine the plans proposed for an improved system of sewerage for the city.

GEO. R. HARDY has resigned his position as Chief Engineer of the Lake Shore & Michigan Southern Railroad. It is stated that his successor will be J. O. Osgood, now Chief Engineer of the Toledo, St. Louis & Kansas City Railroad.

The Business Situation.

The strong points in the business situation just now are the great demand for all or nearly all kinds of manufactured products, the abundance of money for the needs of the people, the low range of values, the sufficiency of stocks, the lightness of stocks and the great consuming capacity of the country. Were the attempt made to pick out the weak points it would be necessary to strain possibilities. For instance it would be necessary to assert that this extraordinary activity cannot be indefinitely maintained, that production is rapidly overtaking consumption and that it is only a question of time when the former will overtake the latter, that the absence of a permanent and elastic banking system jeopardizes the basis of manufacturing and industrial activity and that the downward tendency in prices is destined to carry the industries and business of the whole country into disorganization. Then evil influences could be borrowed.

Are we not threatened by a tariff reduction? Have not the granger roads cut rates all around? Have not steel rails dropped from $40 to $32? Are we not threatened by a falling off in railroad building activity and does not all this mean a depression in trade, manufacturing and financial circles? Possibly. If it will do the pessimist class any good we can add probably. But what of the immense momentum of force that has been treasured up by the country, what of the wealth accumulations that have been going on for two or three years, what of the margin of safety that improved processes and economic changes have created? The country can withstand a great deal more than it could have withstood five or ten years ago. Its accumulated wealth, its capacity for diversified industry, its commercial elasticity, so to speak, all serve as breaks to any possible evils.

The railroad construction of the past five years has brought within reach millions of acres not before available. This is an overlooked factor. How many tens of millions of industrial capital have been invested in the West and South during these same five years, creating new markets. This also is an overlooked factor. Then again, the corporate and municipal and personal indebtedness has not grown correspondingly. That means that there is more money for legitimate enterprise, less interest, less speculation, easier prices and greater regularity in the commercial exchanges.

In fact when the problem of our development and progress is carefully studied it is surprising to see how many new and conserving factors have been introduced to strengthen the situation, to make investments safe and to guard our vast reproductive agencies against the danger of reaction or depression. Yet the possibility and the probability of a depression should never be lost sight of. There are elements always at work in that direction. The earning capacity of all forms of wealth is almost phenomenal. The fact that out of 101 railroads only 4 show a decrease in earnings for 11 months past, and that the excess of earnings for all, on the same mileage for same time last year, was nearly 36,0 0,000 dollars, ought to go far to scatter doubt as to the wisdom of railroad investment during the past 3 or 4 years.

Receivership is declining, non-earning railroad properties are declining in number. The great iron industry is in excellent shape. Rail buyers are waiting for a weakness in rails, at present quoted and sold in a small way at $32 to $33. A large amount of business is awaiting the harmonizing of the views of makers and buyers.

The consumption of iron is steadily increasing and a great deal of additional capacity is under construction, South as well as North. The pig iron production has reached the highest known limit and prices are strong in all markets for standard and special brands. Bar, plate and pipe mills have been kept busy all fall and have fair prospects for the winter, and bridge works are crowded with contracts for winter construction.

The outlook is fair, but there is a tendency to closer competition, no doubt due to the constant enlargement of capacity and its nearing the point where productive and consumptive requirements must equalize themselves. Numerous extensive engineering demands will be presented. Locomotive makers and car builders have their capacity pretty well taxed and railroad managers have yet large orders to place before the opening of spring.

SOCIETY PROCEEDINGS.

Engineers' Club of Philadelphia.—Record of business meeting, Dec. 3, 1887. President T. M. CLEEMANN in the chair; 36 members and 1 visitor present. Officers to serve during 1888 were nominated. Mr. PERCY T. OSBORNE presented an illustrated paper on the Palmetto Railroad, the connecting link in a new through line to the South. Mr. B. B. OSBORNE presented an illustrated paper upon the "Unaccountable Deficiency in the Track of American Railways." Mr. OSBORNE deprecated the continued use of the unsatisfactory spike; offered a suggestion for a spike-headed bolt partly in accordance with established English practice and partly of his own design—to pass entirely through the tie; stated that this design was in no way patented; and particularly requested full discussion of the subject by the members of the Club. Considerable informal discussion followed. The Secretary presented to the Library, on behalf of Messrs. R. B. & P. T. OSBORNE, Active Members of the Club, a handsome copy of WILLIAMS' copper plate mounted Map of the United States, Canada, Mexico, Central America, West Indies, etc., which was received with a vote of thanks.

The Decennial Anniversary of the organization of the Club (on Dec. 17, 1877,) will be observed by a reception to be given at the Club House, on Saturday evening, Dec. 17, 1887.

HOWARD MURPHY, *Sec'y. and Treas.*

Engineers' Club of St. Louis.—283nd meeting; Dec. 7, 1887. The club met at Washington University at 8.10 P. M., President POTTER in the chair, 2 members and 3 visitors present. The minutes of last meeting were read and approved. RENO DEO. JOHNSON, OSCAR W. RAEDER, JAMES C. SIMPSON and ALBERT H. ZELLER were elected to membership. Applications for membership from the following parties were read and referred to the executive committee: I. C. HUBBELL, ROBERT H. MCMATH, J. W. SCHAUB, JAS. M. SHERMAN.

The committee on nominations of officers for the coming year reported: For President, M. L. HOLMAN; Vice-President, J. A. OCKERSON; Secretary, WM. H. BRYAN; Treasurer, C. W. MELCHER; Librarian, J. B. JOHNSON; Directors, WM. B. POTTER and F. E. NIPHER. On vote the report was accepted.

ROBERT MOORE, Chairman of Committee on Relations with Mercantile Library, reported progress. No definite agreement had been reached as yet, but he felt confident the club's wants would be fully provided for. President POTTER then read the report of the executive committee, which showed the club to be in a prosperous condition. P. M. BRUNER then read a short paper on "Action of Frost on Concrete Work." He explained the difficulties met with, and reported the results of a series of experiments he had made on Portland cement; also offered suggestion for counteracting the influence of low temperatures. He said the addition of salt would lower the freezing point one degree for 1 per cent. addition up to the point of saturation, and would also increase the tensile strength. The discussion was participated in by ROBERT MOORE, J. A. SEDDON, WHEELER, Prof. JOHNSON, OCKERSON, MACKLIND, FLAD, HOLMAN and CALDWELL. But little reliable data was to be had. Prof. JOHNSON offered to make a series of tests. It was shown that the best work was secured between the temperature of 45° and 70° Fah.

W. H. BRYAN, *Sec'y.*

Engineers' Club of Kansas City.—A regular meeting of the Club was held at the Club Rooms, Dec. 5, at 7.45 P. M. There were present 10 members and 6 visitors.

The minutes of the last meeting of the Club, and of the Executive Committee, were read by the Secretary and approved. The Secretary then read, in the absence of the author, a paper entitled "Deviation of the Ship's Compass," written for the Club by Mr. H. C. PEARSONS, of Ferrysburg, Mich. After a brief discussion it was moved, by Mr. MASON, that a vote of thanks be extended to Mr. PEARSONS for his valuable paper, and to Mr. KIERSTED for the paper presented at the previous meeting. The motion was carried. Mr. WADDELL then read some abstracts from a paper on "General Specifications for Highway Bridges of Iron and Steel," describing at length the letting of county bridges with some defects of methods in use. Notice was given by the President that the annual meeting would be held Dec. 19.

KENNETH ALLEN, *Sec'y.*

An Underground Tubular Railway for Paris.

M. J. BERLIER, a civil engineer, has submitted to the Parisian authorities a design for an underground tramway for that city. He proposes a tube of cast-iron about 20 ft. in diameter resting in a bed of beton and coated over all with Vassy cement. He would make his tube with 6 segments, each one 3.28 ft. long and 1 in. thick. Each plate would have an overlap and be connected by bolts with sheets of lead between.

Inside the tube would be two tracks, with 3.6 ft. between inner rails. The rails, weighing about 50 lbs. per lin. yd., would rest on cross beams supported on cast-iron brackets in the shell, and be further supported in the middle by brick piers.

Crossings, where necessary would be in flat tunnels and the motive power would be by electricity; the tunnel being lighted in the same way. M. BERLIER depends for ventilation upon shafts placed

about 325 ft. apart, and opening to the upper air in ornamental kiosks. He estimates the cost of 9.7 miles of this double track line at about $11,000,000.

PUBLICATIONS RECEIVED.

Catalogue of the Martin Anti-Fire Car Heater Company, Dunkirk, N. Y., pp. 47, 9 × 12 ins. 22 plates.

It is indeed gratifying to see that steam heating from the locomotive has made such progress as to call for the publication of such a catalogue as this, which is very handsomely gotten up with full drawings of every detail of the apparatus manufactured by the company. From it we learn that the Boston & Albany have one third of their stock already equipped, and are rapidly proceeding with the whole, that the New York Central have adopted and are applying it, as we noted last week, and also the Erie, Buffalo, Rochester & Pittsburg, New York, Providence & Boston, Intercolonial, Kings County Elevated, Beach Creek, Clearfield & Southwestern and Providence & Worcester; while a number of the Chicago roads, the Dunkirk, Allegheny Valley & Pittsburg and Long Island are using it in part. The nature of the apparatus we have often heretofore described and there has been no important change in it since we have done so. A paper by Mr. C. P. CARR, C. E., is printed at the end of the volume which discusses the amount of steam required to heat a car in considerable detail, concluding that it is equivalent to 1¼ to 2 H. P.

"*The Great Pyramid*" will be described in *Scribner's* for January by Edward L. Wilson, the expert photographer and traveler, whose article on "The Modern Nile," in the September number of this Magazine was exceedingly popular. The illustrations from the author's photographs and from drawings will be very rich.

Steam Boiler Explosions, in Theory and in Practice. By R. H. THURSTON, M. A., Doc. Eng. Director of the Sibley College, Cornell University, etc. New York, John Wiley & Sons, pp. 171, 5 × 7½ ins. 63 engravings, very badly indexed.

This volume is stated by the author to be the result of investigations which he has made on behalf of the United States Government, and for other reasons, from 1872 to date, and it is doubtless the most complete monograph on its subject in existence. It is of a strictly practical nature, advancing no new or startling theories, but fairly summarizing the somewhat conflicting mass of evidence on its subject. It is a work which might well be in the hands of every one having to do with steam boilers, either in design or use, and is apparently intended for such use, as it is so written that most of them could read it understandingly and with profit, whether scientifically educated or not, although the treatment of the subject is thoroughly scientific.

Like every other one of the now long list of Prof. THURSTON'S books it is provided with a most wretched apology for an index. Some of them have none at all. We recall no one in the whole list of technical writers who is so great and so chronic an offender in this respect as Prof. THURSTON, and when it goes to such a length as it has in his case, and when the offense is so often repeated, it may reasonably be assumed to argue a certain mental and moral obliquity which cannot but be injurious to his fame, for it is an offense absolutely without excuse, and one which, we should imagine, no one with the spirit of science within him could be guilty of. We say this in all kindness, and trust the warning will be taken to heart.

Mechanics of Materials.—"A Treatise on the elasticity and Strength of Beams, Columns, Arches, etc.," for students of Engineering. By IRVING P. CHURCH, C. E. 8 st. Prof. C. E. Cornell, New York: John Wiley & Sons, pp. 312, 8 vo., 258 cuts, $3.00.

This is merely the second part of the author's treatise on "Statics and Dynamics" separately bound. The preface and the index given are for the entire treatise the paging begins at 195 and the cuts at Fig. 192. It is a valuable treatise which we have heretofore noticed but one of a highly theoretical character.

Hall Steam Pump Co.'s Catalogue.—A new illustrated catalogue of the Hall duplex steam pumps has just been issued by the Hall Steam Pump Co., 91 Liberty street New York. The special features of these pumps are described and several types illustrated, including piston and plunger patterns, deep well pumps, compound pumps, etc. Tables of sizes and prices are given and a page is devoted to "Useful Information."

The New Northwest. By W. J. MORRIS, of Perth, Ont. This is a brochure of 8 pages describing the region of Canada north of the Saskatchewan river, which will be opened up by the projected Winnipeg & North Pacific R. R. It is an interesting and readable pamphlet mostly a compilation from various reports, etc., on what is almost a *terra incognita*.

The Weather of the United States for the Month of November, 1887.

[As respects the elements of most interest to engineers.]
According to special returns from the Chief Signal Officer of the U. S. Army.

STATION.	TEMPERATURE. Degrees Fah.				WIND VELOCITY. Miles per hour.			PRECIPITATION. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average	Max.	Direction. Max.	Total.	Hardest in 24 hours.	No. rainy days.
NORTHERN CITIES.										
Northfield, Vt.	32.4	62.3	1.9	60.4	9.2	40	NE & NW	3.82	1.06	12
Portland, Me.	37.7	65.7	7.6	58.1	8.5	37	SE	4.74	1.75	11
New York City.	43.7	53.9	37.2	16.7	10.6	48	W	2.04	0.60	7
Pittsburg, Pa.	44.8	74.2	14.2	60.0	7.8	30	E, NW & S	1.37	0.67	6
Chicago, Ill.	34.0	67	−1	68.0	12.4	36	SW & NW	2.41	0.60	7
Omaha, Neb.	30.6	79.6	−13.6	93.2	8.1	42	NW	0.89	0.66	4
St. Paul, Minn.	31.2	70.2	−20.5	90.7	5.9	38	W	0.65	0.18	8
Duluth, Minn.	Reports not received.									
Bismarck, Dak.	28.4	72.8	−25	97.8	9.6	59	NW	0.11	0.04	7
Average.	37.0	68.2	0.1	68.1	9.	41.3		2.	0.7	7.8
SOUTHERN CITIES.										
Washington City.	45.0	70.	23	47.0	6.0	30	NW	1.83	0.76	8
Louisville, Ky.	46.1	75.1	8.4	66.7	7.4	36	W	2.51	0.91	8
St. Louis, Mo.	44.8	79.3	10.5	68.8	12.4	54	SW	4.61	2.32	6
Savannah, Ga.	56.4	78	25.6	52.4	5.7	23	NW	0.29	0.20	6
Leavenworth, Kan.	42.8	80.3	−4.3	84.6	7.0	36	NW	1.14	0.66	6
Jacksonville, Fla.	66.9	78.2	26.4	51.8	7.3	24	W SW & N	0.10	0.02	7
Chattanooga, Tenn.	50.1	76.1	16.3	59.8	5.7	41	NW	1.08	0.73	4
New Orleans, La.	61.1	80.1	34	46.1	12.1	24	N NE & NW	0.52	0.31	5
Memphis, Tenn.	51.5	76.3	17.8	58.5	6.1	36	W	4.06	2.27	6
Palestine, Tex.	56.5	79.8	20.3	59.5	7.4	48	S	1.86	0.74	4
Average.	51.5	77.3	17.8	59.5	7.7	35.2		1.8	8.9	6
FAR WESTERN CITIES.										
Helena, Mont.	34.0	66	−11	77.0	6.2	34	NW & W	0.22	0.18	2
Fort Angeles, W. T.	Reports not received.									
San Francisco, Cal.	55.2	73.7	42.1	31.6	5.9	25	NW	0.99	0.48	5
Salt Lake City, U.	43.7	67.0	11.3	55.7	3.6	23	N	0.25	0.25	1
Denver, Col.	40.4	73.7	−14.2	87.9	7.1	36	NW	0.22	0.14	2
Yuma, Ariz.	64.0	90.6	37.8	52.8	4.6	21	N	2.43	1.71	3
Santa Fé, N. M.	41.9	67.0	14.9	52.1	5.4	25	N	0.66	0.24	6
Average.	46.5	73.0	13.5	59.5	5.5	27.		0.8	0.5	3.3

Tunnel Near Galena, Ill., on the Minnesota & Northwestern R. R.

Mr. JAMES FOWLER, engineer of the tunnel near Galena, Ill., on the Minnesota & Northwestern R. R., sends us the following interesting data on the progress made, timbering methods, etc: The tunnel is being driven through blue Cincinnati shale, non-supporting and crumbling rapidly when exposed to the action of either air or water; with water it works up into a most disagreeable, sticky compound of the consistency of *good* mud. It has all to be blasted with dynamite, the lower grades of powder working better than the higher.

The size of the excavation is 24 ft. 9 in. high (being taken out a foot below grade) by 24 ft. wide and it is timbered with 12-in. pine set 2 ft. centers. At first a semi-circular form for the arching with seven segments was used. Plumb posts 14 ft. long, resting on a sill of 4-in. oak. The wall plates, on top of the plumb posts and under the arching, are of 12 × 12 × 16 oak. The semi circular form however spread and the joints opened more or less and extra sets of timbers had to be put up to support the original ones. so the form was changed to an oval shape and the plumb posts shortened to 10 ft. making a stronger and much prettier looking arch and one which, as yet, has shown no sign of spreading, or the joints of opening. There are still seven (7) segments in the arch. No mortise and tenon work is used and only small dowels, just enough to hold the timbers while being set. The excavation is worked by a heading and bench, the bench being generally about 30 ft. back of the heading. A drift on each side of the heading, along the line and level of the wall plates, is kept about 15 or 18 ft. ahead of the heading proper and lines and levels are set on the wall plates as they are placed in position.

The tunnel was worked both ways from a shaft, and towards the shaft from each end, but the east ends have met. Work is carried on day and night. The progress for the past four weeks is here given by weeks:

	Week End. Nov. 19.	Week End. Nov. 26.	Week End. Dec. 3.	Week End. Dec. 10.
East End.	35 ft.	36 ft.	43 ft.	40 ft.
West End.	39 ft.	37 ft.	42 ft.	43 ft.
Total.	74 ft.	73 ft.	85 ft.	83 ft. = 315 ft. for the four weeks.

The tunnel is 2,442 ft. long.

The contractors are Shepard, Winston & Co., and it is to the personal superintendence of Mr. W. O WINSTON that the rapid advance and high character of the work is due.

The Snake River Canal, Idaho.

The *Cassia County Times*, Idaho, in its issue of Nov. 25, gives the report of FRANK RIBLETT, County Surveyor, on this extensive work, and from it we make the following abstract:

The preliminary survey is completed. If the canal starts at Gibson's Ferry its length to West Cottonwood would be 200 miles; to cover Salmon River valley it would have to be 250 miles long. The report discusses quite fully the several proposed routes, but gives the first named as the best. Mr. RIBLETT advises a thorough examination of the several divides by an organized engineering party, beginning their work above Eagle Rock and going, at least, as far west as Salmon river, or better yet, across Owyhee county into Oregon. The report states the belief that by commencing above Eagle Rock the canal could attain sufficient elevation to irrigate all the good land south of the Snake river and north of the mountains.

The country to be run through is very well adapted to agriculture; there is little side-hill work or rocky ground, and about four-fifths of all the work will be on level ground. The side-hills to be met with are usually under 5°; occasionally the slopes increase to 10°. Rock is not in solid ledges, but in loose washes, and the masses are not large. From a close observation of cuts and gulches the percentage of even loose rock will be small. The country is easy of access from railroads at all seasons of the year. From Gibson's Ferry to Hubbs' ranche at least 600,000 acres of good land can be covered; and in Salmon valley, about 400,000 acres more. Below the Bruneau river lie 500,000 to 600,000 acres of good land which can be covered by an extension of the canal. Mr. RIBLETT thinks the cost of the work will not exceed $2.00 for every acre of land covered; but he promises a further estimate of cost.

The Semi-Tropic Land and Water Company of Los Angeles, Cal.

This company, in southern California, is expending from $300,000 to $500,000 in the survey and subdivision of its 32,000 acres of land and in the development of the storage of water for irrigation purposes and domestic use. This water comes from the Sierra

Madre range of mountains; artesian wells will also be resorted to.

The general plan of development is to drive tunnels near the base of the mountains at favorable points, chiefly at the northwest side of the main cañon. The rock is principally gray granite, presenting many fissures in which the water from rainfall and melting snows is stored up. The water from these tunnels is conveyed in small lateral pipes to a main pipe leading to a box flume at the mouth of the cañon. This flume is 700 ft. long, and leads to an open cement-lined ditch 10 miles in length, conducting the water to the distributing reservoir.

At the head of the flume the water is deflected by two cribs securely anchored to the bed-rock in such manner as to present little obstruction to flood water and drift during the rainy season. The open ditch is about half completed and is to be lined with rough masonry and cemented throughout. It is estimated to carry about 100 cu. ft. of water per second.

In addition to a distributing reservoir there will be a storage and service reservoir for town use; the irrigating and domestic systems being distinct. Where there is little pressure cement concrete pipe will probably be used and at other points riveted sheet-iron pipe will be employed for the irrigation service. For fire pressure and the domestic supply cast-iron pipe will be used.

A sewerage system is being discussed, but there is nothing yet definitely decided upon. A survey and preliminary report are ordered.

The President of the Company is Mr. J. W. TIBBOT; M. M. V. SWEESY is Secretary, and Mr. F. C. HOWES, Cashier of the Los Angeles Bank, is the Treasurer. The Chief Engineer is Mr. BURR BASSELL, and his assistants are Messrs. M. H. VAN FRANK and C. A. BAGGESS. The address of the Company is Los Angeles, Cal.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

CONTINUED FROM PAGE 354.

Texarkana, Ark.—The works were commenced Jan. 1, 1887, and accepted Nov. 25, 1887; they were designed by L. METESSER, of New Orleans, who was also Constructing Engineer. The water supply is from 10 wells sunk by Wagner, of Cincinnati. They are 38 ft. deep and in a 26 ft. bed of gravel; the supply seems to be inexhaustible. The pumps are compound, duplex engines, built by Gordon & Maxwell, of Hamilton, O.; all the machinery is first class. There are 4 miles 785 ft. of mains. The contractors for masonry and foundations were Varner Bros., of Texarkana; for buildings, A. M. Hawkins, of Texarkana; for pumping machinery, L. Metesser, of New Orleans; for pipe and specials, Ripley & Bronson, of St. Louis, Mo.; for trenching and pipe laying, Gorman & Reneck, of Dallas, Tex.; for valves and hydrants, Chattanooga Foundry & Pipe Works, Chattanooga, Tenn. The franchise is for 20 years; the price per hydrant is $100 for the first 100, $75 for the next 10 and $65 for all others. The franchise is owned by J. A. POLHAMIUS and associates, forming the Texarkana Water Co.; President, J. A. POLHAMIUS; Secretary, C. L. SAMPSON; Superintendent, E. N. MAXWELL. The present population is about 10,000. City Engineer A. B. MATSON writes: "Our new water-works are first class in every respect. At the public test Nov. 23, they threw 4 streams through 50 ft. of hose with a 1 in. ring nozzle. One stream was thrown 127 ft. high and the others nearly as high, the wind blowing a gale. This with 120 lbs. pressure. The next morning they did good service in extinguishing a fire."

Nebraska City, Neb.—The works were commenced May 2, 1887, and accepted Nov. 3, 1887; they were designed by S. H. LOCKETT, and E. A. RUDIGER was Constructing Engineer. The contract for the works complete was taken by Comegys & Lewis, of New York. The contractors were, for masonry and foundations, Joseph Burr, of Nebraska City; buildings, Driscoll & Prue, of Nebraska City; pumping machinery, H. R. Worthington, of New York; boilers, Pond Engineering Co., of St. Louis; valves and hydrants, Ludlow Valve Manufacturing Co., of Troy, N. Y.; pipe, specials and stand-pipe, Shickle, Harrison & Howard Iron Co., of St. Louis. Filters were put in by the Hyatt Filter Co. The stand-pipe is 100 ft. high and 12½ ft. diameter. Trenching and pipe laying was done by day work. The franchise is for 20 years, and the price per hydrant is $50. The franchise is owned by Comegys & Lewis, of New York, the works are controlled by the City Water Co.; President, D. P. ROLFE; Secretary, J. W. MAGUIRE. The present population is estimated at 9,000.

CONSTRUCTION NEWS.

Water.

Toronto, Canada.—The expenses of the water-works investigation, including fees for engineers, counsel, witness, stenographer, etc., and legal expenses, will amount to about $9,000.

Elmira, N. Y.—There is apprehension of danger from the pollution of the water supply by the sewage of Corning, which will be discharged into the Chemung river by the newly completed sewerage system.

Hastings, Neb.—A mechanic's lien for $6,699.98 has been filed against the property of the city water-works, being the amount of a claim against the contractor. This raises a case in the courts, involving the question of a mechanic's lien upon water-works property owned by a city.

Water Filtering.—The filtering plant put in at Atlanta, Ga., by the Newark Filtering Co., of New York, has been completed and turned over to the Water Commissioners after a satisfactory test. There are 12 filters, 10 ft. high and 13 ft. diameter, with a daily capacity at the test of 4,216,004 galls. The official test was made under the supervision of R. M. CLAYTON, City Engineer; C. B. HAYNES, Assistant City Engineer; WM. G. RICHARDS, Superintendent of Water Works.

Hayward, Wis.—Recently the village proposed to put in water-works and taxed the whole township for the cost. Hayward is the only place of any size in Sawyer county and has some 1,700 inhabitants. This action was under a law of 1883, which has now been declared unconstitutional, and an injunction has been obtained restraining the village from doing the work.

Anchor Ice.—At Minneapolis, Minn., there has been the usual trouble with anchor ice. The supply was reduced so that the upper floors of high buildings were without water, and in case of a large fire the mills would have had to shut down to give the city their supply. The pumps were run at two-fifths of their capacity. —At Meriden, Conn., the water supply was shut off by ice for several hours Dec. 1.

The Cassin Cup.—About a year ago ISAAC S. CASSIN, C. E., of Philadelphia, Pa., announced his intention of awarding a cup to the superintendent of any of the works in course of construction under his supervision who would construct the best specimen of substantial work at the least cost. On Nov. 21 the cup, a handsome silver goblet, was awarded to ALEX. B. YOUNG, Superintendent of Water Works, Kent, O.

St. Paul, Minn.—At the annual meeting of the Water Board held Dec. 5, Superintendent OVERTON presented his report. During the year 4 miles 3,830 ft. of pipe have been laid on the West side 2 miles and 3,795 ft. of low service pipe on the East side, and 13 miles 5,142 ft. of high service pipe, a total of 20 miles 2,207 ft.; this brings the pipe system up to 103 miles. There were 197 hydrants put in, making a total of 868. The total consumption was 333,954,800 galls. He recommends the laying of 11 miles 966 ft. of high service and 30,975 ft. of low service pipe; at an estimated cost of $198,308.25.

Collapse of a Water Tower.—With regard to the collapse of the water tower at Thomasville, Ga., on Dec. 6, mentioned in our last issue, a correspondent from that city writes us as follows: "A very serious accident happened here Dec. 6. The town is having a water tower built about 70 ft. high, of brick, with center pier, also of brick, to support a steel tank. The foundation seemed to give way, letting the pier settle and fall over, breaking out the side of the tower and killing 4 men (including the contractor) and injuring 3 colored men at work on the building. The brick work was nearly finished."—A newspaper account says: "The accident is attributed to the removal of the scaffold supports, which appear in reality to have acted as braces between the outer walls of the tower and the center pier, a solid piece of brick masonry 6 ft. in diam. Owing to the strain of hoisting brick to the top of the tower an oscillating movement was caused, and the pier tottered and fell, crushing through the outer wall, carrying the scaffolding with seven men to the ground."

The water-works were designed by A. E. BOARDMAN, of Macon, Ga., and the center pier of the tower is said to have been put in in opposition to his advice.

Water Works.—*Maine.*—Portland. The water company desires to change the location of the new reservoir, and to build one with a capacity of 20,000,000 instead of 15,000,000 galls.

New Hampshire.—Newport. A company will be organized to furnish a water supply from Sunapee lake.

Massachusetts.—Brookfield. The dam is being built as fast as possible and pipe laying is progressing. The works will be finished by spring.—New Bedford. The City Council has authorized the issue of $20,000 3½ per cent. water bonds to run 30 years. This is for the extension to Acushnet; the work will not be done till spring but pipe will be purchased now.—Arcola. The town will have a water supply. The water will be pumped by a wind engine from a reservoir to an elevated tank. —Sandwich. Water-works will be established.

Ohio.—Cleveland. The new tunnel will have a capacity of 60,000,000 galls. per day., increasing the supply from the lake to 100,000,000 galls.—Sheldon. Water-works will be established. Address O. OTT.

Virginia.—Marion. The water-works will be built in the spring.

Tennessee.—Covington. A water supply will be obtained from artesian wells.

Kentucky.—Owensboro. The water-works will be enlarged; there will be an additional pump of 3,000,000 galls. capacity; an iron lined well 12 ft. diameter, 43 ft. deep; the pipe system will be increased as follows: 324 ft. of 16-in. pipe, 4,000 ft. of 12-in. 4,000 ft. of 8-in. Consulting Engineer, THOS. J. WHITMAN, St. Louis; Superintendent, H. P. MARTIN. — Mount Sterling. Water-works are contemplated.

North Carolina.—Wilmington. The Wilmington Water-Works Co. will sink a number of artesian wells.

Florida.—Fernandina. The city voted Dec. 6 by a large majority in favor of bonding the city for water-works; preliminary steps to be taken at once.

Missouri.—St. Louis. The Water Department is making extensive preparations for the extension of the water-work next year.

Arkansas.—Pine Bluff. The water-works being built by the Water, Light & Power Co., of St. Louis, will be completed by March.

Michigan.—Frankfort. The Village Council has ordered a special election on the water-works question in January.

Illinois.—Jerseyville. The contractors have commenced boring an artesian well.—Bunker Hill. The City Council has decided to engage an engineer to make plans and estimates for the proposed system of water-works, and to make surveys for the reservoir.—Centralia. The water-works committee has been authorized to ask for bids for water-works on the franchise plan. — Hoopeston. Water-works are projected.—New Brighton. The village authorities have offered the East St. Louis Water Co. $500 a year for mains and hydrants on the principal streets; the company will probably accept the proposition.

Iowa.—Marion. The Marion Water Co. has been incorporated by B. F. SEATON, and others, with a capital stock of $175,000.

Wisconsin.—Merrill. The City Council will accept the works on condition that the pipe line is laid across the Wisconsin river, without expense to the city, and that after such crossing is made the company shall make another test of the works as to power and capacity, after June 1, 1888. The rental for use of the works to commence from that date.

Wyoming.—Rock Springs. The water-works for the great coal mining camp of the Union Pacific R. R. are nearly completed. The water is brought 15 miles from Green river to a reservoir. E. C. KINNEY, of Denver, Col., is engineer in charge.

California.—Pasadena. Water-works will be established. Address E. H. ROYCE.

Texas.—Galveston. Proposals for the new water-works are invited (See the first advertising page).—Houston. The Houston Street Railway Co. is experimenting with artesian wells.—The East El Paso Town Co. will put in a system of water-works.—Marshall. The City Council has received a proposition for a system of Wagner steamed wells.

New Mexico.—Lordsburg. Water-works are now under construction.

Grafton, W. Va.—

Dec. 10, 1887.

EDITOR ENGINEERING NEWS.—We had a disastrous fire July 5, causing a loss of $100,000, and since then our city authorities have been deeply interested in the subject of some system of water-works that would answer our purpose and not be too expensive. The Council have requested me to prepare specifications to be submitted to the people at the spring election, taking place in March, for ratification or rejection. If ratified we will commence in the spring to erect the works. Our town is on a hill side with very high hills around it, and part of the town is 200 ft. above the water supply; consequently we will have to put our reservoir from 350 to 400 ft. high. We have hills surrounding us high enough for any elevation required. Our supply is the Valley river, the principal branch of the Monongahela, rising in the mountains in the southern part of the State; pure and fine water. H. S. WILSON.

Washington, D. C.—The condition of the new water supply on Sept. 30, last, was as follows:—The dam across the Potomac was completed in Aug. 1886; this is a solid masonry structure 2,837 ft. high and from 4 to 20 ft. deep, well backed with rip-rap. The tunnel has been completely excavated, and 8,767 ft. is lined, but the remain-

ing 11,929 ft. must also be nearly if not all lined. The cost of the tunnel has exceeded the estimate, and $320,000 more is required to finish the work. The reservoir is now nearly completed and there is sufficient money on hand to put it in condition to receive water.

Patchogue, N. Y.—The works of the Suffolk County Water Co. have been completed and were opened Nov. 29. At the trial everything worked admirably except that when a test from a hydrant was about to be made a plug in one of the branches left for hydrants blew out, the engineer having suddenly run the water pressure up to 95 lbs. and over. There are two duplex Gaskill engines with a daily capacity of 750,000 galls. each, manufactured by the Holly Manufacturing Co., Lockport, N. Y.; also a boiler 16 ft. long and 5 ft. diameter. Between 4 and 5 miles of 10, 8 and 6-in. mains have been laid. The supply is drawn from four 6-in. wells, 40 ft. deep in coarse white sand and gravel; the water rising to within 2 ft. of the top. The wells have been tested for a daily supply of 1,500,000 galls. and the pumps only lowered the level of the water 8 ft. The stand-pipe is 100 ft. high and 20 ft. diameter; it was built by the Southwark Foundry & Manufacturing Co., of Philadelphia, Pa. The pumping station was built by E. Bailey & Sons, of Patchogue. JOHN LOCKWOOD is president and engineer of the company.

Pine Bluff, Ark.—The city granted a franchise for water-works in March, and the works are now under construction. The source of supply is from a bed of coarse gravel, 8 to 10 ft. thick, beginning at a depth of 90 ft. below the surface; the water is confined by strata of tough clay, and when these are pierced the water rises to within 40 ft. of the surface. The supply will be drawn through perforated pipes to a pump well 25 ft. diameter, sunk with an iron caisson to the last clay stratum over the gravel. The gas and ice companies already draw a supply from the same source, and the water is of excellent quality. The machinery consists of 2 compound, direct acting, condensing engines of 1,500,000 galls. daily capacity each, and two 100 H. P. steel boilers with rocking grates. The water is pumped to a steel tank, 40 ft. high, with a capacity of 250,000 galls.; it is carried on 21 combination wrought-iron columns, 70 ft. high. The pressure from this will be sufficient for buildings 5 stories high, but direct pressure can be applied when required. The pipe system is 9½ miles and will probably be increased considerably during construction. The pipe is furnished by Shickle, Harrison & Howard, of St. Louis, Mo. The works will be completed early in Februar . F. WM. RAEDER, of St. Louis, Mo., is Consulting Engineer.

Gas and Electric Light.—*Bath, Me.* The Bath Electric Light Co. has its plant nearly ready for operation. The station contains an engine and dynamo from the Westinghouse Co., of Pittsburg, and another from Armington & Sims, of Providence, R. I. President, F. A. SAWYER; Secretary, F. H. TWITCHELL.

Dover, N. H.,—The Dover Electric Light Co. has put its plant in operation. There are 200 arc lights and 800 incandescent lights. H. W. BURGETT has an exclusive franchise.

Homer, N. Y.—The Homer Water-Works Co. has made a proposition to light the streets by electricity.

Alexandria, Va.—The gas works will probably be enlarged. Address the mayor.—J. M. HILL is organizing an electric light company.

Rome, Ga.—The Rome Gas Co. proposes to put in an electric light plant but has not decided as to the best system. The gas works will be enlarged in the spring.

Gainesville, Fla.—Gas works will be built by W. J. WINEGAR, of Palatka.

Anna, Ill.—The St. Louis agency of the Edison Electric Light Co. will put in a plant at a cost of about $8,000.

Jamestown, Dak.—An electric light plant has been contracted for. The light will be applied to streets and buildings.

Riverside, Cal.—Gas works are to be constructed.

Proposals Open.

Levees.—The STATE BOARD OF ENGINEERS, Baton Rouge, La.

Well.—For gas or oil; 3,000 ft. if necessary. G. W. MEILY, Secretary, Harrisburg Natural Gas Co., P. O. Box 473, Harrisburg, Pa. Dec. 20.

Pier Work.—Removing part of old pier 35, Franklin street, North river, and building new pier. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. Dec. 22.

Water Works Supplies.—H. E. SICKLES, Secretary, Water Board, Albany, N. Y. Dec. 28.

Bridge.—Across Stone river at Stewart's Ferry. JOHN OVERTON, Nashville, Tenn. Dec. 28.

Granite Paving.—CHAS. H. WILCOX, Warden, City Hall, Danbury, Conn. Dec. 26.

Sewers and Street Work.—Sewers; regulating, trap block and granite block paving. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. Dec. 28.

Iron Bridge.—Across English river at Howick village; span 105 ft. D. R. HAY, Secretary of the Municipal Council, Howick, P. Q., Canada. Dec. 29.

Water Gates.—Ten 3-in. (privilege of 5 additional), 25 4 in. (10 ad.), 125 6-in. (50 ad.), 15 12-in. (5 ad.), 2 16-in. (3 ad.), 16 20-in. (2 ad.), 2 24-in. (1 ad.), 2 36-in. (1 ad.). All 16, 20, 24 and 36-in. gates must be geared, and 36 in. made to lay on side. Double faced valves. JOHN CAULFIELD, Secretary, Board of Water Commissioners, St. Paul, Minn. Dec. 29.

Gas Lighting.—Public buildings, etc. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers street, New York City. Dec. 31.

Lake Shore Protection.—About 1040 ft.; two rows of piles filled with brush and stone or cedar bark and stone Plans and specifications on file. L. H. COLEMAN, City Clerk, Racine, Wis. January 2, 1888.

Artesian Well.—Depth 1500 ft., unless water is reached before; hole large enough for 5⅜-in. regular oil well casing at bottom. E. L. AGNEW, Mayor, Bonham, Tex. Jan. 5.

Supplies.—Lime, brick, cement, pipe, etc., for sewerage and water supply work. JAS. M. MOORE, Dep. Q. M. Gen., U. S. A., St. Louis, Mo. Jan. 5.

Artesian Well.—Depth 1300 ft. Specifications at the office of C. MCLENNAN, 161 La Salle street, Chicago, Ill The VILLAGE CLERK, Morgan Park, Cook county, Ill. Jan. 7.

Contracting.

Potomac Flats; Washington, D. C.—On this work of reclamation, 5,314,000 cu. yds. of material have been deposited, and an area of 461 acres of marsh have been raised from 4 to 10 ft. above mean low tide.

City Hall.—The City Council, Omaha, Neb., has rejected all bids for the new city hall and the work will be readvertised. ST. A. D. BALCOMBE, Chairman, Board of Public Works.

Water Pipe.—The following proposals for about 30 tons of cast-iron coated water pipe were opened Dec. 5 by the Board of Public Improvements, St. Louis, Mo.: Shickle, Harrison & Howard Iron Co., St Louis, $8,985; R. D. Wood & Co., Philadelphia, $9,255; Cincinnati & Newport Iron & Pipe Co., Newport, Ky., $11,010. The contract was awarded to the Shickle, Harrison & Howard Iron Co.

Water-Works.—*Jacksonville, Ill.*—The following proposals for the construction of water works have been received by F. G. FARRELL, Chairman of the Water Committee: A. L. Strang & Co., Omaha, Neb., $12,500; J. H. Sands, Bloomington, Ill., $13,500; John Cherry, Jr., Jacksonville, $13,750. The contract was awarded to A. L. Strang & Co., who will sink 6 or 8 artesian wells near the present city pumping works; the supply is to be 1,000,000 galls. per day.

Athens, Tenn.—The Athens Mining & Manufacturing Co. has awarded the contract for the plant for the water-works, which will cost about $15,000, to the Union Iron Works, of Chattanooga.

Manitowoc, Wis.—The franchise for a system of water works has been awarded to Moffett, Hodgkins & Clarke, of Watertown, N. Y., for 20 years: they will commence work in the spring. There will be two pumps of 1,500,000 galls. daily capacity each, and the supply will be drawn from filtering galleries on the Lake Michigan shore. There will be 12¼ miles of 6 to 16-in. pipe, with 132 hydrants, at an annual rental of $6,500.

Hammond, Ind.—The contract has been awarded to E. B. Wingate, of Chicago; pumphouse, chimney and reservoir, $4,125; pumps and boilers, $3,271; stand-pipe, $4,301.80. E. B. Wingate, of Chicago, is Engineer.

Wiarton, Ont., Canada.—The contract for water-works was awarded Dec. 7 to John D. Ronalds, of Brussels, Ont., for $7,500. Work is to be commenced in the spring as soon as the frost is out of the ground, and to be completed and in working order by June 15, 1888. W. D. GALLOWAY is Municipal Clerk.

Street Work.—*Newark, N. J.*—The contract for repaving Chestnut street with oblong granite blocks has been awarded to B. M. & J. F. Shanly at $2.65 per sq. yd.

Avondale, O.—The contract for improving Gallup avenue has been awarded by LATHAM ANDERSON, C. E., of Cincinnati, to Charles M. Steele; excavation, 31 cts. per cu. yd.; coarse and fine macadam, $1.90 and $2; gravel, $2; board gutters, $1 per sq. yd.; inlets for surface water, $18; 12-in. and 6-in. drain pipes, 98 cts. and 45 cts.; 12 and 6-in. Y branches, $1.20 and 50 cts.; plain and junction manholes, $40 and $48; dry rubble and mortar rubble masonry, $2.70 and $4; 12-in. sewer pipe, $1.50; total, $8,992.70.

St. Paul, Minn.—The following bids for 3,200 sq. yds. of cedar block paving for 20th avenue bridge have been received by the Road Committee: G. E. Whittier, 88 cts. per sq. yd.; Wm J. Cribbie, 92 cts.; Thos. E. Snyder, 97 cts.; T. J. Canney, 99 cts.; W. E. Forrestal, $1.04; Thos. Riley, $1.10, J. T. Forrestal, $1.10. The contract was awarded to G. E. Whittier.

St. Louis, Mo.—Contracts for grading and paving have been awarded as follows, by the Board of Public Improvements: G. Eyermann, $1,848; Fruin-Bambrick Construction Co., $1,011.60, $630.40, $3,868.45, $3,922.45; T. F. Byrne, $728; J. B. O'Meara, $750, $707.60; J. E. Perkinson $1,651.35, $1,476.35, $1,262.10; H. Brockschmidt, $2,127.40; M. Lorenz, $1,400, $705.50, $1,256; H. Seibert, $1,044; J. S. Steffen, $1,072.80, $1,688.60; M. Skrainka, $1,340.

Shore Protection at Coney Island, N. Y.—In consequence of a change in the condition of the beach caused by recent high tides, R. Kanters & Son, of Holland, Mich., the contractors for the protective work, have submitted to the Park Commissioners, Brooklyn, N. Y., plans for a proposed change in the work, contemplating the extension of the work westward instead of eastward. In their letter they state that "the severe test of recent high seas has demonstrated the success of the sand spur system."

Street Improvement.—The following are the proposals for improving Considine avenue, Cincinnati, O., received by the Board of Public Affairs:

		J. Bolan.	T. Floyd.	M. Byrnes.
Broken stone,	cu. yd.	$1.80	$1.95	$1.80
Coping,	lin. ft.	.90	.80	.75
Crossings,	"	.90	.78	.60
Curbs,	"	.80	.80	.80
Drain pipe, 24-in.,	"	3.90	2.50	2.50
" 15-in.,	"	2.90	1 00	1.80
" 12-in.,	"	2.50	.80	1.10
" 6-in.,	"	1.50	.30	.70
Gutters,	"	.80	.95	1.00
Flag gutters,	"	.80	.80	.80
Grading,	cu. yd.	.28	.29	.30
Uncoursed masonry	"	4.50	3.90	4.00
Dry drain	" "	3.50	3.00	3.00
Limestone paving,	sq. yd.	1.50	1.50	.90
Rolling,	"	.05	.05	.05
Gravel, cu. yd.		2.00	2.00	2.40
Well hole plates,	lb.	.05	.05	.07
Totals		$36,995	$37,905.30	$38,196

Pumping Engine.—The following proposals for a pumping engine with a daily capacity of 15,000,000 galls. were opened Dec. 8 by the Water-Works Trustees, Columbus, O.:

A. J. Loretz, Brooklyn, N. Y. For duplex, compound, vertical type engine, $65,000; for duplex beam engine, $70,000; for another type of duplex beam engine, $56,000. For the old pump he offered $3,500.

Robert Wetherill, Chester, Pa. For duplex, compound, condensing, etc., engine, $77,000. For the old engine, $4,000.

Holly Manufacturing Co., Lockport, N. Y. For duplex, compound, condensing, etc., engine, $73,500. For old engine, $3,000.

E. P. Allis, Milwaukee, Wis. For duplex, compound condensing, etc., engine, $75,000; for triple expansion engine, $90,000. No bid for old pump.

The specifications called for a duplex, compound, condensing engine. The bidders were the same as those who bid under the former advertisement (see p. 338).

New Croton Aqueduct.—The following proposals for the gate-house at South Yonkers, N. Y., were opened Dec. 14 by the Aqueduct Commissioners:

	John Pierce, 601 Lexington Av., New York	O'Brien & Clark, 40 Wall St., New York.
Granite dimension masonry, cu. yd.	$45	$15
Broken ashlar, cu. yd.	$35	$40
Hammer face dressing, sq. ft.	80 cts.	80 cts.
Rough pointed face dressing, sq. ft.	50 cts.	40 cts.
Roof (complete)	$1,700	$3,000
Double doors (complete)	100	200
Windows (complete)	20	50
Wrought-iron (not in roof)	80	100
Cast-iron (not in roof)	98	80

Harvard Bridge.—The following proposals for the iron superstructure of the Harvard bridge across the Charles river between Boston and Cambridge, Mass., were received by the Commissioners of Harvard Bridge on Dec. 10: King Iron Bridge & Mfg. Co., Cleveland, O., item A, $153,900; item B, 4⅛ cts. per lb. Keystone Bridge Co., Pittsburg, Pa.; $156,500, 4⅛ cts. per lb. Boston Bridge Works, Boston, Mass.: $161,900, 4⅞ cts. per lb. Union Bridge Co., New York City; $161,980, 4¾ cts. per lb. Cofrode & Saylor, Philadelphia, Pa.; $164,000, 4¾ cts. per lb. New Jersey Steel & Iron Co., Trenton, N. J.; $178,067, 5⅛ cts. per lb. W. G. Coolidge & Co., Chicago, Ill.; $179,990, 5¼ cts. per lb. Edge Moor Iron Co., Wilmington, Del.; $179,000, 5⅛ cts. per lb. Berlin Iron Bridge Co., East Berlin, Conn.; $183,700, 5⅜ cts. per lb. Smith Bridge Co., Toledo, O., $190,000; 4⅝ cts. per lb. Groton Bridge Co., Groton, N. Y.; $189,000, 5½ cts. per lb. Wrought-Iron Bridge Co., Canton, O.: $199,026, 5⅞ cts. per lb. Atlantic Works Boston, $198,000, 5¾ cts. per lb. The contract was awarded to the Boston Bridge Works.

Timber.—The following proposals have been received for furnishing the Docks Department, New York City, with 1,500,000 ft. B. M. of sawed yellow pine timber: Dexter Hunter, $25.95 per 1,000 ft. B. M.; Cooney, Eckstein & Co., $26.90; Joseph W. Duryee, $27.87; Joseph Hilton, $28.50; Francis E. Southard, $33.75.

Water-Works, Sewers, Etc.—HULL & PALMER, Civil Engineers, Bridgeport, Conn., are making the surveys and plans for a system of water-works and sewers for the village of New Canaan, Conn. They are also at work on the West Winsted, Conn., water power improvement and storage; several dams and canals will have to be constructed; also a tunnel from 2 000 to 3,000 ft. long, which will be about 10 ft. by 12 ft. in cross section.

Street Lighting.—The following proposals have been received for lighting the city of Stockton, Cal., for two years from January next: Jenney Electric Co., for 100 electric lights, 11 towers 100 ft. high, with not less than 3 lights on each tower, and balance of lights, 67, on arm lights 50 ft. high, and 2 free for the City Hall, $13.75 per light per month, $1,375 per month or $16,500 per year Stockton Gas Light & Heat Co., for gas per lamp per month, $3.90, per year $959.40; or $3 per lamp per month for gas, and $10.50 per light per month for 50 electric lights, $15,150 per year. The contract was awarded to the Jenney Electric Co. C. A. CAMPBELL, City Clerk.

Grading.—The following proposals for street grading were received Dec. 6, by ST. A. D. BALCOMBE, Chairman, Board of Public Works, Omaha, Neb.: Hugh Murphy, 17¼ cts. per cu. yd.; C. A. Jensen, 17½ cts.; Chas. E. Fanning & Co., 17½ cts.; Callihan & Co., 18½ cts.; Shannon & Hoge, 19½ cts.; C. F. Williams, 20 cts.; G. W. McKinney, 20½ cts. The contract was awarded to C. A. Jensen.

The following proposals for grading Boylston street have been received by JOHN W. MCDONALD, Superintendent of Streets, Boston, Mass.: Moulton & O'Mahoney, Laurence, 85 cts. per cu. yd.; Neil McBride, Brighton, $1.07.

Broken Stone.—The following proposals for about 6,000 tons of broken stone were opened Dec. 6, by the Board of Park Commissioners, Boston, Mass.: Patrick Grace, $1.23 per ton; Hugh Nawn, $1.25; Mark Wilmouth and James Killin, $1.26.

Handy to Have.—"Well, it is a plaguy handy little thing to have around anyway."

The above remark was overheard from a well known architect the other day, regarding that popular little tool illustrated on advertising page VIII., and known as the adjustable curve ruler.

It was first introduced to the craft during the winter of 1884-5; it steadily gained favor, and is to-day extensively used by draughtsmen in every part of the United States and territories.

RAILROADS

East of Chicago.

Existing Roads.

Chicago & West Michigan.—An extension from Baldwin to Traverse City, Mich., is under survey by a corps in charge of H. F. NORTHROP with J. F. DEIMLING and GEO. H. NORTON as assistants.

Cincinnati, Wabash & Michigan.—The project for building the line from Anderson to Rushville, Ind., which has lain dormant for some time, is revived by a prospect that the "Big Four" company will aid in the work.——The 8 mile extension to Cedar Beach, Ind., has been abandoned, a trackage right having been secured over the Baltimore & Ohio.

Boston & Maine.—The last spike was driven on Dec. 8, completing the Central Massachusetts road on the Boston & Lowell division from Cambridge to Northampton, Mass., 103 miles. The residents of Northampton did not boil over with enthusiasm in the manner common on such occasions in booming communities of the West and South. When the last rail was being put in place and someone suggested that a golden spike was the proper thing to complete the work, it was remarked that Northampton had driven golden spikes enough for the road. The completion of the line has been delayed for several weeks, waiting for the erection of the bridge across the Connecticut river. This is 1,505 ft. long, with 9 through spans, and was built by the R. F. Hawkins' Iron Works, of Springfield. The original Central Massachusetts company was chartered in 1869, and the Northampton people who voted a heavy subsidy in aid of the scheme many years ago, have grown rather weary of waiting for the completion. As the first train came into the town it was remarked that it was only about 20 years behind time.

Detroit, Lansing & Northern.—The Grand Rapids Lansing & Detroit extension from Grand Ledge to Grand Rapids is nearing completion. The extension is 53 miles in length and is being graded by McRae & Lalley of Grand Ledge. It is not likely that ballasting, etc., will be finished ready to open the line for business before Spring. A new Union depot is to be built at Grand Rapids, plans for which are now under examination.

Knox & Lincoln.—At the recent annual meeting of this Maine company, it was voted to make a contract with the proposed Lime Rock company by which the Knox & Lincoln will secure a trackage right over the eight miles of road from Rockland to Camden.

Boston & Maine.—The annual report to the stockholders states that the company has purchased in the past year 16 locomotives, 15 passenger cars, 25 gondolas and 200 dump and flat cars. Contracts have been let for a double track iron bridge across the Merrimac river at Newburyport to be completed next spring. In reference to the Union station and improved terminals, at Boston, the report states that plans and drawings are in preparation, and that the directors intend to go on with the improvement as fast as possible. The funds for the work are to be obtained by a special issue of bonds known as "Boston & Maine Terminal Bonds."

Lake Shore & Michigan Southern.—The Mahoning & Shenango Valley line was opened for business Dec. 10, and well be known as the Sharon branch.

Flint & Pere Marquette.—The company has secured right of way for a belt line at East Saginaw, Mich., and also a site for a new depot in the central part of the city.

Cleveland, Akron & Columbus.—The new line from Killbuck to Dresden Jc., Ohio, was opened for business Dec. 7. The line is 34 miles in length and has one 1450 ft tunnel. The company contemplates the construction of a branch to coal fields in Coshocton county.

Delaware & Hudson Canal Company.—It is stated that the company will begin work in the spring on a line from Rutland to Woodstock, Vt., a distance of 20 miles. The line has been surveyed several times. It would give a western outlet for the Woodstock road, and as Hon. FREDERICK BILLINGS is interested in this as well as in the Delaware & Hudson the report seems a probable one.

Toledo, Ann Arbor & North Michigan.—Great opposition has been shown toward the extension to Cadilla: by the farmers along the line. Recently one of them, by the name of CHAPIN, built a barricade across the completed grade, and when the tracklaying gang came up CHAPIN and his sons, who were armed with rifles, ordered the tracklayers to stop work or be shot. Engineer DAVIS, who was in charge of the tracklaying gang, ordered his men to tear down the barricade, and a general melee ensued. Several shots were fired and one young man of the tracklaying gang was fatally wounded. CHAPIN and his men were disarmed but managed to escape.——On the Toledo, Saginaw & Muskegon road, the last rail was laid Dec. 5, near Sparta, completing the line from Ashley to Muskegon, 95 miles.

Pennsylvania.—An extension of the Lake branch of the Northern Central Railway to Naples, N. Y., is under consideration.——The Panhandle repair shops at Columbus, O., are to be thoroughly overhauled and considerable additions built.

Baltimore & Ohio.—At the Director's meeting, held Dec. 10, SAMUEL SPENCER was elected President in place of ROBERT GARRETT, resigned. Vice-President THOMAS M. KING has resigned his office.——Some work is in progress in Philadelphia on the extension to coal wharves on the Delaware river. Several short extensions which are rumored are not likely to become realities at present.

New Projects and Surveys.

Kinderhook, Valatie & Stuyvesant.—This is the rival project to the Columbia & Rensselaer, in Rensselaer county, N. Y. CHAS. D. HAINES, 45 Broadway, N. Y., is interested.

Ohio Valley & Terminal.—This company has been incorporated to secure a terminus for the Ohio Valley railway in Evansville, Ind. CHAS. VIELE, of Evansville is interested.

Zanesville, Newcomerstown & Cleveland.—This Ohio company is securing right of way for its proposed line. FRANK MISKIMEN, of Newcomerstown, O., is interested.

SOUTHERN.

(N. B.—Pressure on our space compelled the omission of our Southern items in last week's issue.)

Existing Roads.

Georgia, Southern & Florida.—Tracklaying has begun at Macon, Ga.

Covington & Macon.—It is stated that Col. E. C MACHEN will complete the road to Athens, if the suit brought by the creditors can be settled.

Atlantic & Gulf.—This is the new name of the Blue Spring, Orange City & Atlantic road. S. B. CARTER, of Orange City, Fla., is Chief Engineer, and is making surveys for the proposed extension to Tavares.

Georgia, Midland & Gulf.—The construction company have turned over the completed line of this road to the railroad company. G. GUNBY JORDAN has been elected General Manager of the latter. The contract for building the Columbus Southern road from Columbus to Albany, has been let to the Chattahoochee Brick Co., of Atlanta. JOHN L. COWAN will be Engineer-in-Charge.

Central Railroad of Georgia.—Tracklaying has begun on the line from Clayton, Ala., to Blakely. The Goodwater extension is delayed by two long tunnels, in which the rock is unusually hard. Trouble has also been experienced in getting hands for the work. A semi annual dividend of 4 per cent. has been declared.

Louisville, New Orleans & Texas.—A large amount of work has been done this season in building new freight sheds and terminals at Carrollton, on the Mississippi near New Orleans. The work has been in charge of G. A. HOPKINS and GEO. BLANCHIN, Assistant Engineers of the company. The contractors for the work were Kauffman & Pierson, and S. D. Stafford, of New Orleans.

Rome & Decatur.—The bondholders have arranged with DANIEL CALLAHAN, of Rome, Ga., the contractor who built the completed portion of this road, to finish the gap between Rome and Gadsden. The road is to be completed by Feb. 15 next, which will necessitate two months of very active work.

Montgomery & Florida.—At the recent stockholders meeting, N. T. SPRAGUE of Brooklyn, N. Y., was elected President, and Dr. M. P. LEGRAND of Montgomery, Ala., Vice-President. The new managers intend to build the extension of the line at once.

Georgia, Carolina & Northern.—The Monroe & Chester division is being pushed rapidly along. President R. F. HOKE, of Raleigh, N. C., is letting contracts for the division from Athens to Atlanta. The survey is in progress between Athens and the Savannah river.

Charleston, Cincinnati & Chicago.—The survey is nearly completed from Rutherfordton to Marion, N. C.

East Alabama.—Tracklaying is completed to Roanoke, Ala.

Louisville Southern.—The contract for the Lawrenceburg and Lexington branch has been let to Mason, Gooch, Hoge & Co.——In regard to the line from Harrodsburgh to Richmond, reported as surveyed on our map of Oct. 8, a correspondent writes: "I helped survey the line, but he is a sanguine man who thinks it will ever be constructed."

Nashville, Chattanooga & St. Louis.—Tracklaying is in progress on the extension of the McMinnville branch.

Louisville, St. Louis & Texas.—Most of the work has stopped on this line and will not be resumed until next spring. A reconnoissance has been made for the proposed branch to Hardinsburgh, 10 miles in length.

Illinois Central.—Two parties of engineers are at work on the Cairo and Memphis line. The report that the company is soon to absorb the Mobile & Ohio seems to have very slight foundation.

Birmingham & Atlantic Air Line.—All work has stopped on the Savannah, Dublin & Western line and the contractors, Munday, Carpenter & Grant, are trying to obtain the amounts due them for work done.

Pittsburg, Cincinnati & St. Louis.—The branch to New Cumberland, W. Va., was opened for business Dec. 8. The line is 10 miles in length.

Georgia Pacific.—The company has just purchased four consolidation engines, three passenger engines, three switching engines and 400 box, dump and coal cars. It is reported that work will begin in the Spring on the long delayed extension across the State of Mississippi. The line will run *via* Carrollton.

Kansas City, Memphis & Birmingham.—It is stated that engineers in the employ of the company are making a reconnoisance for the projected extension from Birmingham to Savannah.

Richmond & West Point Terminal Co.—The annual meeting was held Dec. 13 at Richmond, Va. The system now has an extent of 4,700 miles. President SULLY'S report refers to the invasion of the company's territory by other lines, and shows the necessity of early consolidation of independent lines into large systems. The Clarkesville, Blue Wing & Durham project is stated to be controlled by interests friendly to the Terminal company. The company has applied to the Virginia Legislature for a charter for a line of railway from Danville to Bristol, Tenn. This move is supposed to indicate a probable absorption of the Danville & New River Narrow Gauge.

Louisville & Nashville.—It is stated that the company has decided to complete the Pensacola and Selma divisions at once. The line is now in operation from Selma to Pineapple, Ala., 38 miles, and from Pensacola Jc. to Repton, 29.63 miles, leaving a gap of about 35 miles on which considerable grading was done several years ago. This move is made by the company in order to compete with the new line of the Mobile & Birmingham.

New Projects and Surveys.

Chattanooga, Cleveland & Murphy.—The name of this road is to be changed to Chattanooga, Hiawassee & Augusta. The line is intended to furnish a new and short route from Chattanooga to Augusta, Ga., and develop the rich mineral deposits along its course. The total length will be about 240 miles. Surveys are now in progress, right of way and subsidies are being secured, and it is hoped to begin work in the Spring. There will be two large bridges on the line and probably five tunnels, the longest, 1,900 ft. in length: HENRY E. COLTON, Murphy, N. C., is President, and J. A. KELLY, is Chief Engineer.

Owensboro, Falls of Rough & Green River.—President A. C. TOMPKINS has engaged J. N. ALSOP of Owensboro (Ky.) to make surveys for this proposed line.

Atlanta & Selma.—Considerable enthusiasm is being stirred up in Atlanta over this proposed line. It is to be built, according to the plans which its projectors have publicly outlined, by "construction companies," and the unusually frank statement is made that, "as a matter of course, the price paid to this construction company or companies will be very high, say about twice and perhaps a little more than twice the cost of the road in spot cash payments." The projectors of the road are now obtaining stock subscriptions in Atlanta. JONATHAN NORCROSS and L. E. O'KEEFE of that city are interested.

Roanoke Railroad & Lumber Co.—This company, proposes a lumber railroad from Reidsville to Plymouth N. C., a distance of 30 miles. The company's headquarters are at Norfolk, Va.

Isbell & Iron Mountain.—This company has been incorporated by GEO. C. ALMON of Russellville, Ala, and others to build a railroad from Isbell to Russellville.

St. Augustine & East Coast.—The survey of this Florida line is in progress. WILLIAM MICKLER of St. Augustine is Chief Engineer.

West Virginia.—A company has been chartered by ROBERT W. MONROE, of Kingwood, ISAAC T. BRADY, of Romney, and others, to build a short railroad near Romney, W. Va.

THE NORTHWEST.

Existing Roads.

Minnesota & Northwestern.—By action of the directors the name of this system will hereafter be Chicago, St. Paul & Kansas City. The Elizabeth tunnel will be completed by the first of the year and it is expected to have through trains running from Chicago to St. Paul by Jan. 15.

Minneapolis, Sault Ste. Marie & Atlantic.—Tracklaying was completed to the Sault on Dec. 9 but no formal celebration will be held until the bridge is completed, early in January.—Several companies are said to contemplate building the proposed line from St. Ignace to the Sault, and it will probably be constructed next season.

Toledo, Peoria & Western.—It is stated that this company is to be absorbed by the Chicago, Santa Fé & California. The line runs from Keokuk on the Mississippi river due east to the Indiana State line.

Duluth & Iron Range.—About 800 men are at work on the extension of this road. H. K. HALVERSON is Superintendent of Construction.

Chicago, Milwaukee & St. Paul.—The company has filed official notice with the Secretary of State of Wisconsin of an intended extension from Mather, Juneau county, 14 miles northwest.

Illinois Central.—The tracklaying is completed on the extension from Cherokee to Onawa, Ia., and to Sioux Falls, Dak., a total distance of 157 miles. The contract for these lines was let August 1, of the present year making the total time occupied in construction but a little more than four months. Preliminary surveys have been made from Washta, Cherokee Co., to Sioux City; from Le Mars to Yankton, Dak.; and from Osage City, Mitchell Co., west to a connection with the new line to Sioux Falls, a total of about 250 miles.

New Projects and Surveys.

Chicago, Hinsdale & Southern.—This company has been chartered in Illinois by DAVID A. COURTER of Hinsdale and others to build a railroad from Chicago to Shawneetown with a branch to Streator.

St. Paul & Southern.—This company has been incorporated in Minnesota to build a railroad from St. Paul to Des Moines, Ia. The officers are: President, A. P. JAMISON, Cashier Waseca Co. Bank; Secretary, P. C. BAILEY of Waseca; Chief Engineer, F. D. WOODBURY, Des Moines, Ia.

Winona & Southwestern.—It is reported that the officers of this Minnesota company have succeeded in negotiating $8,000,000 of bonds and will begin active operations in the spring. WILLIAM MCINTYRE of Winona is interested in the contract. WM. MITCHELL of Winona is President and JOHN WILLIAMS is Chief Engineer.

St. Ignace & Sault Ste. Marie.—Several companies have been reported to contemplate building this proposed line on the north Michigan Peninsula from Mackinaw Straits to Sault Ste. Marie, about 65 miles, and there is little doubt that it will be pushed through next season.

Kansas, Nebraska & Decatur.—This company has been incorporated by ARTHUR W. DALE and others of Decatur, Neb., with a capital stock of $3,000,000.

Duluth & Tower.—The latest statement of the foundation of this project is that several of the leading logging companies which have their headquarters at Duluth, wish to open up the great forest tracts along the St. Louis river and will build a system of lumber roads as feeders to a main line which will be solidly constructed and used for the transportation of both freight and passengers. The terminus would be on the lower Vermilion range, from which a heavy ore traffic may soon be expected.

THE SOUTHWEST.

Existing Roads.

Atchison, Topeka & Sante Fe.—It is reported that a deal is in progress by which this company will absorb the San Antonio & Aransas Pass system in Texas, which has now about 400 miles of completed road, and will operate it as a part of the Gulf, Colorado & Sante Fé division. Another deal is rumored in Illinois by which the company is to acquire control of the Toledo, Peoria & Western, and thus have an air line from Keokuk to the Indiana State line.—Work on the Chicago Santa Fé & California is now centered on the gap near La Plata, Mo. The tracklaying is to be completed on this by the end of the year without fail.

Kansas City & Southern.—About 800 hands are at work on the line between East Lynne, Mo., and Kansas City.

Chicago, Rock Island & Pacific.—The Chicago *Times* makes the following very sensible comments on the wild rumors concerning this company which are in continual circulation:

"A story has been going the round of the papers that the Chicago, Rock Island & Pacific had recently set two thousand graders at work on its New Mexico line, and that work would be actively pushed all winter, it being the intention to reach El Paso as quickly as possible. While the Rock Island will in time undoubtedly reach the point mentioned, if there are two thousand or any other number of graders at work in New Mexican territory, they are not in the employ of the Rock Island. The extension which is reaching down in that direction is completed and the rails laid to a point within thirty miles of the southwestern border of Kansas, and the road bed graded to the boundary line. The surveys have been made for the line clear across New Mexico, but no contracts have as yet been let for its construction, nor will anything be done until Jan. 15, when the southwestern extension will reach Indian Territory at the point indicated. The same is true regarding the projected Colorado line. There is no question that it will reach Colorado in time, but just where it will strike for or when it will get there is known only to the directors, with the chances that they have not as yet come to a definite conclusion."

"Every few days telegrams come from the west that a party of Rock Island surveyors are at some point, running lines through and over the Rockies, across the Sierra Nevadas, in Nevada, and at numerous other points, and these telegrams always conclude with assertions that the Rock Island is at once to begin construction in the locality referred to. No w, one shingle does not make a house, neither does a surveying party insure a railroad. The Rock Island may go to California in time. If it does not, it will have accumulated a lot of useful information regarding routes and the resources of the western country, besides having kept a number of surveyors employed until their services are needed elsewhere."

Kansas City, Wyandotte & Northwestern.—The company has made its first annual report to the Kansas State R. R. Commission. The length of completed line is 42.3 miles. The capitalization per mile is $39,952.71. While this is undoubtedly a rather watery representation of the actual cost of construction, there is quite a lesson in it for the sanguine projectors of 500 mile roads whose hopes of success are based on local aid and a low cost of construction.

Arkansas & Louisiana.—This Arkansas road which extends from Nashville to Hope and has been partially built to Gibsland and Homer, La., has been placed in the hands of a receiver, W. P. HART of Washington, Ark.

St. Louis & San Francisco.—At the stockholders meeting held at St. Louis Dec. 8, it was voted to issue $50,000,000 of bonds to be used in constructing or acquiring extensions of the system. The bonding shall not be at a rate greater than $20,000 per mile. The issuance of the bonds and direction and amount of extensions is left to the discretion of the directors.

Missouri Pacific.—Tracklaying has begun on the Kansas & Arkansas Valley road, and the 80 miles from Van Buren, Ark., to Fort Gibson, Ind. Ter., are to be finished by March 1.

Kansas City, Texarkana & Gulf.—The preliminary surveys are in progress for this line from Texarkana to Fort Smith, Ark.

Missouri.—The State Railroad Commission estimate the amount of tracklaying on extensions for the current year to be as follows:

Name of Railroad.	Miles.
Cape Girardeau & Western (Brownwood Branch.)	8.0
Chicago, Milwaukee & St. Paul	140.3
Chicago, Santa Fé & California	244.0
Chicago, St. Paul & Kansas City	61.4
Missouri Central	10.0
Missouri Pacific (Lexington toward Boonville)	45.0
Missouri Pacific (Paola to Kansas City)	20.9
Missouri Pacific (Oak Hill and Carondelet)	6.3
St. Louis, Kansas City & Colorado	40.0
Atchison, Topeka & Santa Fe (Atchison to St. Joseph)	13.0
Total	554.9

A correspondent calls our attention to omissions of work in the States of Arkansas and Louisiana upon our map No. 4. The reason for the omission was that it was not thought best to delay the map for complete data from those States, which properly come under the Southwestern division, and will appear on our map and list of that section.

New Projects and Surveys.

Austin & McGregor.—The citizens along the route of this proposed Texas line have formed a company and subscribed a considerable amount to its stock, and intend to begin construction soon on their proposed line, which is to run from Austin *via* Georgetown, Cornhill, Salado and Belton to McGregor, about 85 miles, at an early date. Among the directors are GEO. W. TYLER, of Belton; JOSEPH NALLE and W. H. TOBIN, of Austin.

Wichita, Richfield & Trinidad.—Incorporated in Kansas by F. F. STEVENS and others of Richfield, to build a railroad from Wichita, Kan., to Trinidad, Cal.

Chicago, Jefferson City, Girard & Pacific.—It is reported that contracts will be let, and work begun on this line very soon. W. F. BIGGIE, of Girard, Kan., is President.

Lawrence, Atchison & Southern.—Location is completed between Atchison and Lawrence, and the managers say that construction is to begin early in the spring. J. B. BOWERSOCK, of Lawrence, is President, and W. A. MORTON, of Winchester, Vice President.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Nevada & California.—About 300 hands are at work on the extension to Susanville, Cal.

Southern Pacific.—Chief Engineer HOOD reports that in the 12 months ending Oct. 1, track was laid on 179.32 miles of extensions, divided as follows: California & Oregon, 78 miles; San Miguel extension, 54 miles; Saugus to Santa Barbara, 81 miles, Santa Rosa & Carquinez, 3.3 miles.—Great preparations are in progress for celebrating the completion of the California & Oregon road. Until the opening of this road, the nearest railway route from San Francisco and Central California to Oregon and Washington Territory has been by way of Ogden and the Union Pacific. In other words, the only northern road from California, Nevada, Arizona and Utah has been 600 miles east of the Pacific coast. The distance from San Francisco to Portland by the new route will be about 740 miles. By the former route it was 1,719 miles. The golden spike is to be driven at Ashland, Oregon on Dec. 17, by CHAS. F. CROCKER. Wires will be connected with the spike and the sledge so that each blow will close the circuit and transmit instantaneously the record of the stroke to the offices at San Francisco and Portland and also to other prominent towns where guns will be fired by the electric spark to celebrate the event.

San Francisco & San Joaquin Valley.—J. R. WILBUR of San Francisco, the present head of this enterprise, states that about 50 miles of grading have been completed and the work will be pushed through the winter.

Missouri Pacific.—The state of affairs between this company and the Denver & Rio Grande is still an absorbing topic of interest in Colorado railway circles. A Pueblo paper enlightens the public as follows:

"The *Chieftain* has long since been informed of the fact that the Gould system would eventually own or control the Denver or Rio Grande Railroad, but for prudential reasons the facts have not been made public. When Mr. Gould was in this State last spring he stated to a Denver newspaper reporter that he considered 'Pueblo better situated to control the trade of the State that Denver,' and proceeded to act upon his judgment by arranging to purchase and gain absolute control of the Rio Grande Railroad. In future the Rio Grande will be a feeder of the great Missouri Pacific Railroad, with headquarters at Pueblo, from which point branches will radiate to gather in the riches of the mountains and valleys and leave them in the yards of our smelters and manufactories for reduction and refinement, after which the Missouri Pacific and its branches will carry the refined products to the markets of the world. Neither is there longer a necessity for hiding the fact that the Missouri Pacific proposes to reach the coast via the Rio Grande route, up the Arkansas river from Pueblo, thus giving Pueblo another great transcontinental route."

How the editor of the *Chieftain* could deliberately conceal in his bosom a news item of such importance for months together is inexplicable.

Seattle & West Coast.—It is reported that contracts have been let for completing this road from Seattle, W. T., to a connection with the Canadian Pacific. HENRY CRAWFORD, of Seattle, is President.

Esquimalt & Nanaimo.—It is proposed to construct a branch line to run from Victoria on Vancouver island, B. C., to a point opposite Port Angela, W. T., to connect with a branch of the proposed Port Townsend & Southern road, projected to run to Portland, Ore. JOS. HUNTER, Victoria, B. C., is Chief Engineer.

Electric Railway.—The City Electric Railway Co., Little Rock, Ark., has procured a charter from the council to build several miles of street and dummy railway through the city and suburbs. Ground will probably be broken next month and at least one mile built the coming spring. Part of the line will be a simple street railway and part a dummy road, on which freight and passengers will be hauled. FRED. J. H. RICKON is Engineer for the company.